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VOLUME 3, No. 1 JANUARY 1951

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WORLD CROPS

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VOL. 3 No. 1 — JANUARY 1951

CONTENTS

EDITORIAL COMMENT:
Colonial Development; Smallholder in the Tropics; Zande Scheme; Cotton and the Newer Insecticides; Aerial Top-Dressing; Yorkshire Potash Deposits; Empire Cotton Growing Corporation; Cotton Prospects 1

Tonkin Canes and Rattans—*R. H. Kirby*, B.COM. ... 5

Grasses and Grazing Problems of East Africa—*A. E. Haarer*, F.L.S. 8

Some Impressions of Farming Conditions in Holland and Belgium—*A. M. Smith*, D.SC., F.R.I.C. ... 11

Correspondence 14

Agriculture in Persia 15

Refined Petroleum Oil as an Insecticide—*E. R. de Ong*, PH.D. 19

The Zande Scheme in the Anglo-Egyptian Sudan ... 23

Fourth International Congress of Soil Science ... 26

Mechanisation Topics 28

Overseas Food Corporation Report 29

New Books 31

New Research Station for the Empire Cotton Growing Corporation 33

Farm Machinery; Greater Variety at 1950 Smithfield; 14ft. Tractor Rake: New Light Duster: 14in. Deep Digger 37

World Crop Reports 41

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Editorial Comment

Colonial development

WE had occasion to comment in our September issue on the work of the Colonial Development Corporation and to express the view that it provided the Commonwealth with a powerful economic instrument. Since that date two important events have occurred; the first is the retirement of Lord Trefgarne, who has occupied the post of Chairman of the Corporation since its inception three years ago, and his replacement by Lord Reith; the second is the debate in Parliament on the second reading of the Bill to increase by £20 million the sum of £120 million originally provided for the operations of the Corporation.

To Lord Trefgarne will always belong the credit for having launched the Corporation on its career. The tribute to his leadership and inspiration paid by Mr. Griffith, the Colonial Secretary, in his letter of September 25, is well deserved and many will share his regret that Lord Trefgarne should have felt compelled to take the step in question.

The appointment of Lord Reith as his successor came as something of a surprise. His name in the public mind will ever be identified with the BBC notwithstanding that his connection with that great undertaking terminated in 1938 and that since then he has held numerous other public offices. But leaving apart his two-year period as chairman of Imperial and afterwards British Overseas Airways, he has had little direct experience of Colonial affairs and conditions, a qualification which at first sight seems desirable for ' that objective appraisal from within of the methods and future plans of the Corporation ' which Lord Trefgarne himself considers to be needed. All will, however, wish him well in his great and responsible task.

Under Lord Trefgarne's energetic guidance the Corporation has grown apace. The organisations for which it is now responsible number 49 and will soon, we gather, be increased to the region of 80; its staff at headquarters exceeds 300. Existing schemes are of the most varied description ranging from agricultural projects such as the growing of cocoa in Malaya and British Honduras, rice cultivation in Gambia and North Borneo, and tung oil cultivation in Nyasaland, through mining, forestry and fishery projects to the building of hotels. We have already commented favourably on the caution displayed by the Corporation in regard to its earlier schemes and its unwillingness to embark upon new projects without the most searching examination and preliminary experiment; its expansion has been rapid and so far as can be judged soundly based, but the decision to accelerate gives rise to some misgivings. That these may not be entirely absent from the inner counsels of the Corporation itself seems to be indicated in a recent editorial in the excellent publication issued by them—*Colonial Development*—where the query was put whether the futile policy of His Majesty's Government would be ' more capital or a period of consolidation.' This found its echo in the debate in Parliament when Mr. Henderson Stewart, Member for Fife, East, urged that it would be unwise to force the Corporation to develop more rapidly than it is doing, a point which he had also elaborated in a recent letter to *The Times*.

In winding up the debate Mr. Griffiths, the Colonial Secretary, stated that the Corporation was not intended entirely to replace private investments in the Colonies but to supplement and complement them and to correct the ' evil legacies of the past.' Incidentally, one is impelled to wonder exactly what is intended by the latter phrase. In the past the Colonies undoubtedly suffered from a too parsimonious view of the responsibilities of the mother country towards them, and this perforce reflected itself in carefully controlled Government expenditure. Nevertheless, despite obvious defects born of these restrictions, the record of Colonial achievement at the outset of the last war was one of which Great Britain had no reason to be ashamed. The loosening of the purse strings, of which the Colonial Development Corporation is a symptom, is indeed welcome. But, especially in a grossly overtaxed community, it is as well to remember that attempts at too rapid development are just as likely to be productive of evils as excessive prudence has been in the past.

The smallholder in the tropics

THE reorganisation of peasant farming is probably the greatest single problem which faces the administrator and the agriculturist in tropical countries today. Wherever one turns, in Africa, the Far East, the Middle East, the West Indies, and in tropical America the same problems confront one; their individual aspects may differ but the fundamental considerations underlying them are identical. Briefly they are: (1) how can the agricultural productivity of primitive peoples be raised to enable them to achieve the higher standard of livelihood which on all hands is admitted to be necessary, and (2) how can the effects of rapid population increases, with resultant increasing pressure on the land, be counteracted before irretrievable harm has been done?

In the pages of this journal many aspects of the problem have been considered from time to time;

at the United Nations' conference on the conservation of natural resources held at Lake Success last year a whole plenary session was devoted to the question, regrettably without the emergence of any clear-cut finding, while there is an increasing spate of published papers and reports on divers aspects of the same great question. Meantime 'time marches on' inexorably and, despite local improvements, the problem as a whole becomes ever more and more urgent, reinforced and accelerated by political agitation born of growing discontent with things as they are.

The Zande Scheme

In such circumstances, it behoves us to take into account every new development which offers some prospect of bringing relief in particular areas, and on this account attention is drawn to a project designed to improve the conditions in one of the most remote corners of the tropical world, an account of which appears on another page under the title 'The Zande Scheme.'

This particular project has for its object the raising of the standard of living of the Zande people, a primitive community which inhabits the remote and inaccessible region of the south-western Sudan. These people live in scattered communities and have hitherto practised subsistence agriculture based on shifting cultivation. Their living standards are low and the remoteness of the region and the consequently high cost of transport make it economically impracticable to develop an export trade overseas in agricultural produce, save in the case of products of light weight and relatively high value. Needless to say such products are few and so far none have appeared suitable for this particular region. The climate and soil conditions are, however, not unfavourable to the cultivation of a fairly wide range of products, and the essence of the scheme is to develop the growing, processing and manufacture of suitable products so as to make the region, in the first place, self-supporting in a range of manufactured goods and, in the second, to provide a market for any surplus production within the confines of the Sudan itself, thereby helping to establish a money economy.

It has been termed 'an experiment in social emergence.' The major product selected is cotton, supplemented by sugar and oil palms and conjoined with the continued production of essential foodstuffs. It envisages the construction of modern spinning and weaving mills and the erection of suitable plant to handle the other products, the establishment of trading centres at suitable points, the improvement of communications and the introduction of better educational and health services. The scheme, which owes its genesis to Dr. J. D. Tothill, formerly Director of Agriculture in the Sudan, has now been in progress for four years and is giving promising indications.

It may be remarked that in the past under similar remote conditions more or less parallel developments on a restricted scale have occurred as a result of evolution. An example is the development of the traditional spinning and weaving industry in the northern provinces of Nigeria. This, however, probably took many hundreds of years to establish itself on its present scale. The present scheme represents an attempt to accelerate developments on similar lines with the aid of modern resources and techniques. It is therefore particularly interesting and if it meets with the success hoped for should provide a valuable example of a line of development which might find extended application wherever similar conditions prevail.

Cotton and the newer insecticides

PROBABLY few crops are more subject to depredations from insect enemies than cotton and it is accordingly not surprising that among field crops it has come in for a large share of attention in connection with the use of the newer organic insecticides for controlling insect pests. Naturally this is most in evidence in the southern states of the U.S.A., which still form by far the largest cotton-producing region in the world; nevertheless it has also found its reflection in other cotton-producing regions, *e.g.* in the successful development of large-scale dusting with DDT for the control of Jassids (*Empoasca fícalis*) which have proved so troublesome lately in the Sudan.

An interesting summary of the U.S.A. position has recently appeared in an article on cotton in the latest volume of *Advances in Agronomy*, prepared under the auspices of the American Society of Agronomy. It transpires that today various forms of the chlorinated hydrocarbons have been found effective against the majority of insect pests by which the cotton plant is attacked in the U.S.A., and are officially recommended for their control by the agricultural authorities of the various cotton-producing states. The oldest, DDT, continues to find favour, in 5 or 10% concentrations, against flea hoppers and leaf worms, but for wider range of application mixtures of benzene hexachloride, DDT and sulphur in concentrations of 2-5-40 and 3-5-40 have found extensive use. Particularly interesting is the growing popularity of toxaphene (chlorinated camphene), a comparatively recent development which is reported to be effective against 8 out of the 10 major pests listed, in concentrations of 5 or 10% and applied at a rate of 10 to 15 lb. per acre, either alone or in conjunction with sulphur. It is stated to have given good results against both the cotton boll weevil (*Anthonomus grandis*)—probably the most devastating pest of cotton which the industry has yet experienced—and the cotton boll worm (*Heliothis armiger*). Against the pink

boll worm, probably introduced into the New World from India (where it is indigenous) or from Egypt, DDT is stated to have given promising results.

For many years arsenical insecticides, *i.e.* Paris green, calcium arsenate and lead arsenate, were the chief weapons in the entomologist's armoury against many of the pests of cotton. They were and still are extensively used against such pests as the cotton leaf worm (*Alabama argillacia*). Their high human toxicity has, however, always been a drawback and accidental cases of human poisoning as a result of careless use are not infrequent, while on general grounds it is obviously undesirable that such highly toxic materials should be in general use among labour forces. On this account alone their replacement by the less highly toxic organic insecticides of the chlorine substituted type is obviously desirable.

Aerial top-dressing

IN previous issues we have published accounts of trials that have taken place in the U.K. and New Zealand recently on the application of fertilisers to relatively inaccessible hill-grazing land. The pioneer work accomplished appears to be showing signs of bearing fruit, for already we are informed that the British Ministry of Agriculture have called a meeting to discuss the matter and the technical problems connected with it. We understand a memorandum has been forwarded to the Agricultural Research Council and to the Agricultural Improvement Council, and the suggestion made that the matter should be explored by the Scottish Hill Farming Committee. It seems not unlikely that further trials on a larger scale than the original demonstration at Plynlimmon will be made in the not-far-distant future to determine detailed costings and similar data.

Simultaneously the National Farmers Union have taken the matter up and, in a recent article in their official organ, the *British Farmer*, have also urged a large-scale top-dressing demonstration which, it is suggested, might open the way for the commercial application of the method.

Meantime, from the other side of the world comes the news that the Australian authorities are taking a practical interest in the matter, following the example of their sister Dominion, New Zealand. Thus it is reported that the Government of South Australia proposes to top-dress from the air some 12,500 acres of pasture on Kangaroo Islands at the rate of 1 cwt. of superphosphate per acre. These pastures were seeded last autumn and next autumn it is proposed to seed a further 25,000 acres. By 1953 it is estimated that the aerial top-dressing programme will extend to at least 50,000 acres.

In this matter our compatriots ' down under ' certainly appear to be getting a move on.

The Yorkshire potash deposits

GREAT interest attaches to the decision to develop the Yorkshire potash deposits recently announced in the press. Their existence has been known for many years but their exact nature and probable extent have only been partially revealed during the last 12 years as a result of the work of the d'Arcy Exploration Company, which in 1938 commenced the sinking of a deep borehole near Whitby as part of a programme of prospecting for petroleum, and further subsequent borings carried out by I.C.I.

The deposits were referred to in an article under the title ' Potassium, Master Nutrient,' by Mr. D. P. Hopkins, which appeared in these pages in April of last year, and further detailed information concerning them is contained in a paper recently read before the Newcastle Section of the Society of Chemical Industry by Dr. Alexander Fleck.

It appears that the deposits are of Permian age and lie at a depth of between 3,500 and 4,500 ft.; they are situated in the vicinity of Eskdale and their minimum area has been estimated provisionally at 12 square miles. The most important deposits are two undoubtedly workable beds of sylvinite at a depth of about 4,000 ft., varying in thickness from 12 to 40 ft. with average potassium chloride contents of from 10 to 40%. It has been estimated that they contain at least 200 million tons of potassium chloride, a very appreciable addition to Great Britain's natural resources.

Moreover, at a somewhat greater depth there are extensive polyhalite deposits which have not yet been fully investigated but which are believed to contain at least as much potassium as the sylvinite beds.

At present, it is understood, developments are likely to be confined to the sylvinite beds. The exact techniques to be employed in extraction can only be decided after further experimentation, but the fact remains that although these deposits are deeper than any at present mined commercially in other countries, the quality of the sylvinite compares favourably with any commercially worked potash bed, while their thickness is only rarely exceeded in any known potash field.

It is estimated that British agriculture alone requires about 200,000 tons of potash annually to maintain crop production and soil fertility at its present level. If therefore it is assumed that only 35% of the sylvinite deposits can be extracted and no account is taken of the polyhalite deposits, at least 70 million tons of potassium chloride could be made available, an amount sufficient to provide potash to meet British requirements at the present rate for 280 years and leave substantial amounts available for export.

The discovery is therefore an event of major importance to British and overseas agriculture.

The Empire Cotton Growing Corporation

THE opening of the Empire Cotton Growing Corporation's new research station at Namulonge, Uganda, of which an account appears on another page, is an event of interest to all concerned with cotton production throughout the world and particularly in the British Commonwealth.

Founded in 1921, the Corporation's aim is the extension of and promotion of cotton growing in countries associated with the British Commonwealth. Its inception was due to anxieties felt during the 1914-18 war by the British Cotton Industry regarding future supplies of raw material; this led to the setting up by the Board of Trade of a committee to enquire into the possibilities of increased production within the British Empire and as a result the Corporation was inaugurated, the necessary finance being provided by a grant from accumulated funds by the British Treasury and by an annual cess on cotton manufactured in this country. The Corporation is in this respect unique, and its foundation is a tribute to the energy and foresight of the British Cotton Industry.

From the start the Corporation concentrated on research and experimentation, as it was felt that this must be the basis of any large and enduring developments. In the early years activities were spread over a large number of territories, including Australia, Fiji, the Anglo-Egyptian Sudan, Uganda, Tanganyika, Nyasaland, Northern and Southern Rhodesia, South Africa, Swaziland and the West Indies in order to explore the possibilities. The two largest stations were respectively located in Trinidad in the West Indies and at Barberton in South Africa, the former being concerned with long-range research on genetics and physiology, and the latter with plant breeding, entomology and crop husbandry. At Barberton the U4 variety, which is the basis of most of the cotton now grown in Southern Africa, was evolved.

As a result of experience it was decided early in the present decade to concentrate major research activities in the more important producing areas, and in pursuit of this policy the stations at Barberton and in Trinidad have been closed and the new station at Namulonge inaugurated. The Corporation, however, continues to maintain staff and research activities in the Sudan, Tanganyika, Nigeria and in the West Indies, where a cotton officer is maintained to help and advise with the small but very important Sea Island cotton crop.

During the 29 years of its existence cotton production in Commonwealth countries (excluding India) and the Anglo-Egyptian Sudan has expanded from approximately 166,000 bales to 863,000 bales, an increase, which although small compared with total world production, is nevertheless a very considerable achievement. There can be no doubt that the work of the Corporation and its officers has contributed very substantially to this. Moreover, exact information has been made available concerning the possibilities and prospects for further production of cotton throughout the Commonwealth. The establishment of the new research station in Uganda and the excellent organisation which has been established to enable it to maintain close contact with Departments of Agriculture, research workers, growers of cotton, manufacturers of cotton products and official authorities, is an outstanding example of successful collaboration.

Cotton prospects

THE outlook for cotton was dealt with in a group of broadcast talks in the Home Service of the BBC recently under the title of ' Taking Stock in the Cotton Industry.'

As Sir Ralph Lacey said in his opening remarks, ' It is rather a grim process at present. Not only is there a shortage of almost all types of cotton, due to short crops and reduced plantings, but the spinning and weaving industries are also experiencing difficulties owing to labour shortages and the need for replacing obsolescent machinery.'

Prices for raw cotton have risen steeply with a corresponding rise in the price of manufactured cotton goods, while there is increasing competition from synthetic fibres which are now considerably cheaper than cotton. Indeed it seems they may be officially pressed into service to curb the rising cost of living. Thus, in a recent speech Mr. Harold Wilson implied that great economies could be made in the cost of textiles by encouraging the use of synthetics in partial replacement of natural fibres.

Obviously present prices may bring temporary wealth to the cotton-producing countries, but their continuation may be disastrous. Increased yields and lower production costs are therefore vitally important. Moreover, the bulk of the short staple cotton is produced in dollar countries and this hampers supplies. Substantial increases in production in Commonwealth countries might greatly alleviate difficulties, especially if they could be made available at lower prices. We believe that this is by no means an impossible achievement and here also the new research station in Uganda should be able to render invaluable service.

THIS MONTH'S COVER

Windmills, canals and polders. This is a typical scene in the agricultural country on the outskirts of Rotterdam. In the background can be seen some of the buildings of that city.

(Photo: K.L.M. Royal Dutch Airlines.)

Tonkin Canes and Rattans

R. H. KIRBY, B.Com. (Lond.)
Colonial Products Advisory Bureau

Bamboos and rattans figure in many aspects of the daily life of communities throughout the world. The so-called Tonkin canes, grown only in one district of China, are the most valuable of all bamboos because of their straightness and toughness. Rattans are used for a variety of purposes and come from a number of countries in the Far East. The cultivation, preparation and marketing of these interesting products is described below.

TONKIN canes are the culms of *Arundinaria amabilis*, a bamboo which occurs only in a limited area, oval in shape and about 25 miles long, in the district of Wai Tsaap, Kwangsi Province, and in a small part of the adjacent district of Kwong Ning in Kwantung Province, Southern China, with the small village of Au Tsai as the centre of the area. This region is almost entirely given over to the production and export of bamboo, so much so that even rice is imported for the needs of the inhabitants.

Locally the bamboo is known as Ch'a Kon Chuk, or tea stick bamboo, and the name Tonkin cane is really a misnomer. *Arundinaria amabilis* grows to a height of 50 to 60 ft. and the groves are usually confined to hillside lands. It has not been observed growing wild.

Cultivation

McClure has described the cultivation and production of the tea stick bamboo. Land which has lain fallow for some time is preferred for new plantations and the wild vegetation on it is first burned and the soil cleared of roots, which are also burned, the ash being spread as fertiliser.

Planting usually takes place in February. The propagating material consists of clumps of one or two upright culms from established plantations, with portions of the rhizome attached, preferably about one or two years old. The rhizome should have some viable buds, and the culms some leafy branches at the nodes within two or three feet of the ground, above which height the culm is lopped off with a knife. These are placed in holes just big enough to take the new plant, which have been dug at random at distances from six to ten feet apart. When planting it is important that the earth should be packed tightly all round the rhizome so that it is in close contact with the soil and water supply. Sometimes cassava or another crop is put in with the bamboo as a cash crop. Normally rainfall is depended on for the water supply.

Javanese rattan. It is not unusual for the stems of these climbing palms to be 500-600 ft. long

During the first year of planting there is generally little sign of growth, but in the second spring as many as 30 shoots may arise from one plant. However, even under favourable conditions, it is four to five years before any marketable culms are produced and about ten years before the grove reaches maturity and produces culms of the maximum size. The average life of a grove is stated to be about 40 years, but many areas are probably harvested for much longer.

Flowering

During periods of flowering, which may last as long as five to ten years, the grower suffers considerable loss, since plants which have flowered undergo a repression of vegetative activity for some years. Although they do not die, the rhizomes only produce small flowering culms of no commercial value and production is consequently seriously reduced. As flowering declines, the vegetative activity is gradually recovered and progressively larger culms are produced from the clump until they again produce normal culms. It is important, therefore, that only young plants from a grove in full vegetative vigour should be selected for planting new groves.

Harvesting

Harvesting is carried on throughout the year, the maturity of the culm rather than its size being the important factor. The culms are cut just below ground level by means of a strong oblique blow with a heavy sharp knife. The branches are removed from the culms, and the culms are made into convenient bundles for carrying and taken to the nearest stream, where they are sorted according to size, again bundled, and floated downstream to the scouring beach.

Scouring

At the scouring beach the culms are scoured with wet sand, chiefly by women and children. They are then tied into standard bundles and stacked in the sun to become dried and bleached, a process which takes about one week in favourable weather. At night and during rain they must be placed under cover.

After this curing the culms are carefully sorted into groups according to size, sawed to the lengths desired by the export agents, and tied into bundles of standard sizes to be carried by boat down the Sui River to the Chinese export dealers at Fatshan. The export dealers carry out the final processing of the bamboo, having large plants for this purpose.

Straightening the culms

Although the tea stick bamboo is the straightest of all bamboos grown in Southern China, most culms have small crooks which are removed by the export dealer in the following manner.

The bamboos are stacked for a time in bundles on racks situated above earthenware firepots without chimneys, in which a special kind of smokeless coal is burned. Two large bricks are laid across the top of each firepot with a space of about one and a half inches between them, through which pass most of the hot bluish flames from the coal. These slowly warm up the canes on the racks, and the worker, seated on a low stool in front of his firepot from which he can reach the bamboos without getting up, puts them one at a time into the channel between the two bricks and holds them there in motion for two to three seconds. They are then withdrawn and straightened while warm by means of a special tool. This is made of a round tapered piece of wood about one foot long, about three-quarters of an inch in diameter at the narrow end and about one and a half inches at the wider end. It contains towards the wider end an open groove about three-quarters of an inch wide running crosswise and is used as a lever by means of which the crooks in the bamboo can be straightened. The heating and bending has to be done for each crook separately, and the bamboo must be held rigidly in the required position until the tissues have cooled, after which the straightening remains permanent. A slightly different technique is used for straightening the larger bamboos, but the principle is the same.

The heating given to the bamboo helps to destroy the powder post beetle, *Dinoderus minutus* (F.), and its eggs; it bores into this and other bamboos. Exposure to the sun also helps and each export dealer has his sunning-yard where the culms are given regular exposure to the sun while awaiting straightening. Experiments in Puerto Rico have shown that a 5% solution of DDT in Diesel fuel oil gives protection against the beetle for as long as two years, especially if applied to the green stems.

After straightening the culms are sorted, cut and packed for shipment to agents in Hong Kong, Canton and Shameen, who in turn export them to the world's markets.

Grades

In European markets the culms are sold according to thickness and length. Chinese statistics classify them as below 25 mm. in diameter or 25 mm. and above. The length varies from 2 to 14 ft. The culms are sold in Europe in bales varying from 4,000 to 250 according to size, and price is based on a unit of 1,000 culms.

A small number of other species of *Arundinaria* occur in the same area as *Arundinaria amabilis* and, although inferior, are often mixed with it, especially when production is low because of an epidemic of flowering.

Tea stick bamboo is valued for its straightness, stiffness, toughness, smooth joints and relative lack of taper. No other bamboo is considered to be its equal.

One of its most important uses is in the manufacture of split-cane fishing rods. The way in which these are made is kept secret and their manufacture requires special machinery and considerable experience. The first step in manufacture is flaming the culms. This is done by suspending the culms, cut into the required lengths, on a rack one at a time over a long gas burner furnished with several small jets. This is said to improve the quality of the culms. After flaming, the nodes on the culm are smoothed down to the level of the remainder of the culm by rubbing with coarse sandpaper. Finally the culms are cut into strips by specially designed knives or saws, and the strips are planed to a triangular shape. Three, four or six of these strips are then glued or cemented together to form the fishing rod. Other important uses are as supports in forest nurseries, in horticulture and for furniture-making.

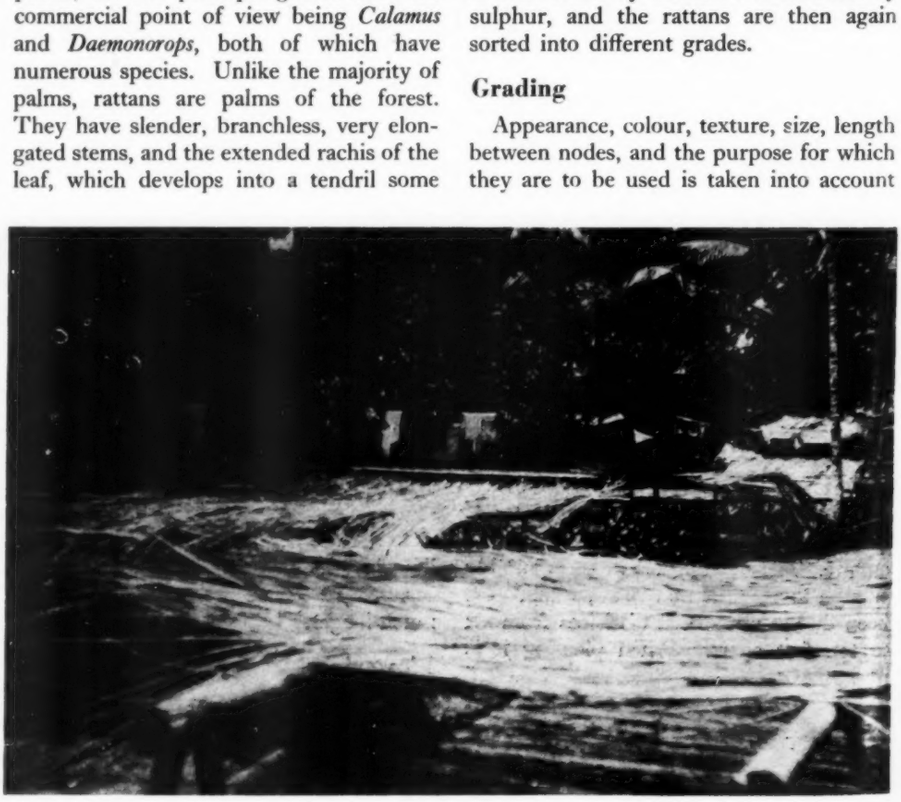
Rattans

Rattans are the stems of various climbing palms, the two principal genera from the commercial point of view being *Calamus* and *Daemonorops*, both of which have numerous species. Unlike the majority of palms, rattans are palms of the forest. They have slender, branchless, very elongated stems, and the extended rachis of the leaf, which develops into a tendril some feet in length, enables them to climb over other vegetation and support themselves on the highest trees. Sometimes the stems are 500 to 600 ft. long and often much longer. The chief commercial supplies of rattans come from the Malay Peninsula, Borneo, Indonesia, China and, to a smaller extent, India and the Philippines.

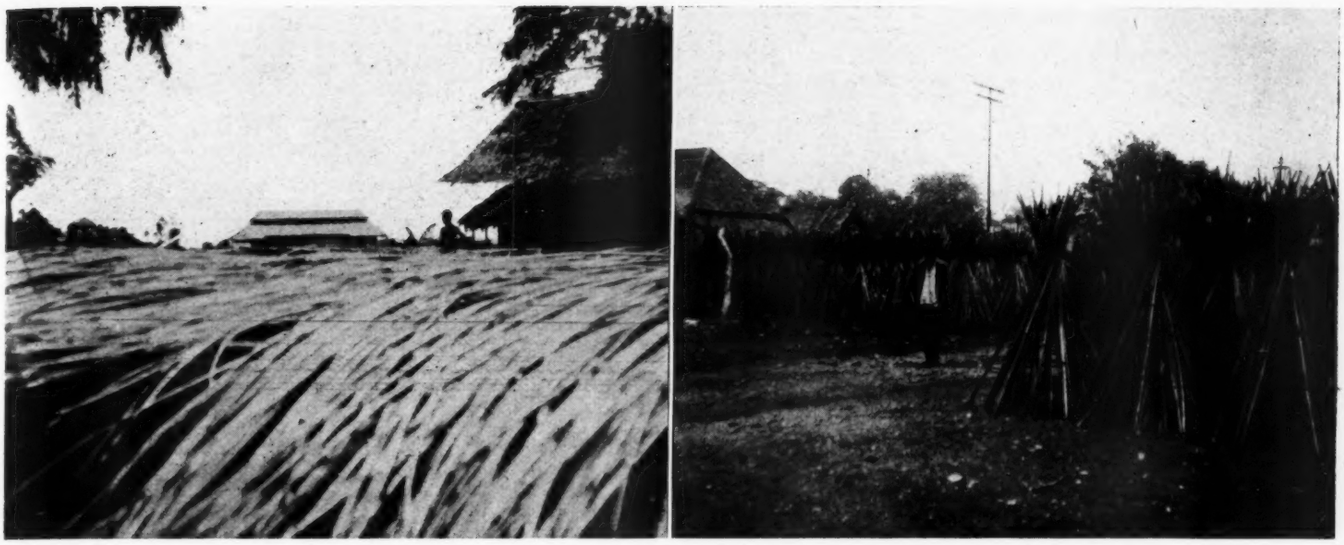
To obtain the best rattans they should not be cut until they are eight to ten years old. All parts of the palm except the stem have spines on them. Cutting is therefore unpleasant and arduous. The collector selects the palm in the jungle, cuts the stem near the foot and pulls it down from the trees over which it has climbed, cuts off the extreme end which has no value, and removes the leaves, often by scraping the stem against another tree. The stems are then dried in the sun, preferably under a layer of sand, cut into lengths of about 16 ft., packed into bundles of about 100 each, and shipped to the main exporting centres at Singapore, Macassar, Sarawak, Celebes, Hong Kong and a few other Chinese ports. Here the rattans are sorted according to size and texture. Some rattans have a siliceous 'glaze' covering to their outer stem and this is removed by pulling the rattan up and down through a bamboo with a groove in it fixed to a tree. The rattans are then washed in running water and scoured with sand. Bleaching is done either by the sun or sometimes by sulphur, and the rattans are then again sorted into different grades.

Grading

Appearance, colour, texture, size, length between nodes, and the purpose for which they are to be used is taken into account



Rattans in a Chinese dealer's drying yard. They are next washed, scoured with sand and bleached



Two ways of stacking rattans for drying under the sun ; those on the right are Malacca canes which are the stems of a particular type of rattan palm

when grading. The best rattans should be strong, light, flexible, of uniform thickness, have a smooth surface and resistance to breaking and splitting when twisted or bent, and have a light yellowish colour. It is held in the trade that the better the colour the better the rattan. Generally speaking, rattans of good length and strength, about one-quarter of an inch in diameter, with a hard outer circle, and with a uniform size and colour are the most desired.

Cultivation

Where natural supplies of rattans are insufficient, cultivation of the palms is carried on in some places, in particular of *Calamus caesius*, the stems of which are always in demand. Van Tuil has described in some detail the cultivation of rattan palms in Borneo. Cultivation is carried on both by natives and Chinese settlers, but the latter bestow more care on their plantations and are stated to obtain higher yields.

When choosing the land, the type of palm to be planted must be taken into account, since different palms have different cultural requirements. Seed is collected from palms when they ripen in January and February and is placed in a basket for about ten days, kept indoors and watered once daily. The friction in the basket is stated to loosen the seed-coat and to hasten the germination. The seeds are then planted in a seed-bed in a shady spot, if necessary covered. They germinate after about two weeks, and the first leaves appear about two or three months after. When the plants are about six months old they are transplanted to a larger bed and left until they are about 3 ft. high, when they are dug out with a ball of earth attached and planted out in the secondary forest at distances of about 16 by 16 ft., care being taken that no injury is caused to the roots. Undergrowth around the plant is cleared for a distance of about 15 ft. and trees are planted which will provide cover and also support for the stems, but at some distance so that the stems will trail along the ground some way before starting to climb. For the first three years the undergrowth is cleared about twice each year and dead and unpromising stems are cut off to allow more stems to develop from the stool. Each plant, if properly planted, will produce about 40 stems. On the best plantations harvesting does not take place until the stems are ten to twelve years old.

Processing

Inferior grades of rattans go chiefly to Hong Kong and other Chinese towns, where the outer layer or bark, known as the cane, is peeled off from the core by hand, rounded and then smoothed, the methods of working being kept secret. Both cane and core are then exposed to sulphur and nitre in a closed room to remove black spots and to bring out the yellow colour. In Europe, particularly in Germany, France and the U.S.A., the rattans imported from Singapore and the other exporting centres mentioned above are passed through specially devised machines which cut both the hard outer cane and the core longitudinally into long strips of different sizes in round, square or flat form. For this purpose only rattans with a compact pith are used.

Rattans are used for furniture, handles, polo-sticks, ski-sticks, drain rods, sunblinds and numerous other purposes, especially where strength, elasticity and light weight are desired. Where strength is most important the whole stem is used, but superior rattans are generally used in the split form.

Malacca canes

These are the stems of *Calamus scipionum* Lour., a rattan palm normally having only a few stems which, however, are very long and often have some long internodes, sometimes as long as five feet. The thickness of the stem varies from half to one and a half inches. Internodes of three feet and longer are used for the best Malacca canes, those in which both the body and the crook are made from one internode being known as ' whole bark ' canes. After harvesting and cutting into lengths the canes are smoked and polished with coconut oil, dried on gravel beds in the sun, and turned at intervals to give them a mottled effect, or put in a sand bath and frequently turned over, being taken out from time to time and rubbed with coconut oil. The best Malacca walking sticks should have both the body and the crook free from flaws, be of good colour, medium thickness, and have as little taper as possible. Such canes fetch very high prices.

Rattans from other sources

From time to time, and especially during the war years, attempts have been made to market rattans from other sources, in particular from West Africa, where the most important species are *Ancistrophyllum opacum*, *A. secundiflorum*, *Calamus deerratus*, *Eremospatha macrocarpa*, *Oncocalamus acanthocnemis* and *O. wrightiana*.

(*Concluded on p.* 13)

Grasses and Grazing Problems of East Africa

A. E. HAARER, F.L.S.

Although the useful grasses of East Africa have been studied for a decade and more, a large number still await attention. Many of the indigenous grasses and their ecotypes require testing; while the composition of mixed leys, the proper management of natural grazing, and the restoration of exhausted pastures in the varying climatic zones, all need investigation. East Africa has already supplied the world with several grasses of abiding value, and there are more to come.

THE collection and identification of the indigenous grasses of East Africa has been in progress for many years, but there must be still a number of new species awaiting discovery in less frequented places. The study of individual grasses and their ecotypes in relation to their use as pasture grasses is still in its infancy.

Environment effects

The soils and climate of East Africa vary widely; the country tends to divide itself into regions for each of which the most suitable grasses require to be chosen and strains bred to meet the vagaries of local conditions. The creeping Digitarias and Cynodons, for instance, have several ecotypes suited to different environments. *Digitaria abyssinica* and *D. scalarum* are noxious weeds on arable land, but they are also excellent fodder grasses; they can be planted to hold freshly made earth banks, and should be useful in preventing erosion on steep slopes unsuited for cultivation where the rainfall is sufficient and evenly distributed. Extensive and heavily grazed pastures of *Digitaria scalarum* exist in community with *Trifolium cryptopodium* (Steud.) on the northern slopes of Mount Elgon at between 9,000 and 9,500 ft. A number of other perennial grasses might be used to preserve contour bunds, the sides of storm drains, and the spillways of dams, but none resist the eroding action of running water better than a Digitaria of the couch grass type provided it can be established.

Eragrostis mildbraedii Pilg. should be a good grass to use where the soil is poor and the rainfall erratic.

Digitaria scalarum in Uganda often lives in community with the indigenous Napier or elephant grass *Pennisetum purpureum* (Schum.) lying dormant while it is overshaded, but becoming prominent, and providing fodder between the tufts of the taller grass when this is burnt off. It has been found in Uganda that a thick planting of Napier (elephant) Grass on land infested with *Digitaria scalarum* helps to keep the latter under control.

Typical topography of acacia country in the Nairobi Game Reserve

Two outstanding grasses

Two grasses have become of outstanding importance in cooler areas where rainfall is evenly distributed, *viz.* Napier Grass, already mentioned, and Kikuyu Grass *Pennisetum clandestinum* Hochst. Unfortunately both must be planted from sets since Napier Grass does not as a rule produce fertile seeds, and Kikuyu Grass bears only a few seeds that are difficult to harvest.

Napier Grass

The tall stems of Napier Grass can be cut in sections and planted like sugar cane, when the sets root and tiller by ratooning into stout tufts. The young initial growth may be grazed *in situ*, but later the grass is cut for stall feeding, or it can be used for ensiling until it becomes too tough as the flowering stage approaches. It benefits from manuring; thus experiments in Uganda showed that plots manured at the rate of 10 tons of kraal manure per acre, and cut at four-monthly intervals, yielded 49,800 lb. of green fodder per acre as against only 17,655 lb. from unmanured control plots. Over a period of several years, there was little or no indication that regular cutting had any detrimental effect on growth.

Napier Grass has been found useful for mulching orchard crops such as coffee; it is widely used for planting to form barrages across eroded gullies and to stop sheet erosion by planting it in lines along the contour. In the latter connection it is useful to cut and lay it along the rootstocks to fill gaps and hold silt, the remainder being used for fodder, for mulching, or for composting. The African also uses the canes for hut building: to form lattices for mud walls as a basis for thatched roofs and to make fences, stockades and ornamental ceilings.

A related grass, *Pennisetum Haareri* Stapf. et Hubb., grows in pure stands in the swampy areas of the Bukoba district of Tanganyika, and probably in Southern Uganda. Unlike Napier Grass which requires a well-drained fertile soil, this grass grows well in wet swampy places which are of little value at present.

Kikuyu Grass

Kikuyu Grass has been taken to many parts of the world and is now well known. It is established by planting pieces of the stems which creep on the soil surface but do not penetrate underground. It soon covers the ground with a close mat of soft growth like a lush meadow; it will stand light frosts and is drought resisting; it is disliked in some regions because it persists

Sward produced by perennial sorghum after cutting

Tufted grasses cut in grazing district of Bukoba [*Photo by Author*

as a weed on land that is ploughed, and must be replanted by sets whenever a pasture is renewed.

Where Kikuyu Grass succeeds, it is invaluable for pastures and leys, especially when the land is manured. In the highland areas of Kenya, Uganda, and Tanganyika it is indigenous and forms a close sward which tolerates heavy grazing and trampling. On the upper slopes of Mount Kilimanjaro it grows in association with at least four excellent indigenous clovers, *Trifolium semipilosum* Fres., *T. subrotundum* Steud. et Hochst., *T. usambarense* Taub., *T. Rueppellianum* Fres. The area is overgrazed, but a lush mixture of clover and grass is obtained whenever such land is rested.

The study of mixed leys has so far been generally in abeyance, and research has concentrated on the more urgent problems of the management of grazing. *Trifolium Johnstonii* occurs in pastures in Kenya to some extent, and a great deal may eventually be possible to bring mixtures of indigenous clovers and grass under intensive farming practice in East Africa. Contour ridging to stop erosion and to conserve moisture on the slopes of drier country where rainfall is badly distributed, coupled with the use of organic manures, can do a great deal to increase the growing period of most grasses and enables them to remain green long after those on untreated country have turned brown; it might make possible the cultivation of Kikuyu Grass in areas hitherto considered unsuitable for it.

Red Oat Grass

Red Oat Grass, *Themeda triandra* Forsk., covers areas of undulating country in Kenya, Uganda, and Tanganyika. It occurs throughout tropical Africa and in South Africa, and is, perhaps, the most valuable natural grass in ranching areas since it grows in almost pure stands. At least three varieties are known; all tender and palatable in early growth. It never forms a close mat, but grows thinly like a field of oats, hence its name.

In the open grass farming region, where the vegetation is transitional between the true Kikuyu Grass area and the Acacia-Themeda community, Oat Grass is specially important but the management of grazing is always difficult. If the grass is grazed too early it is weakened, and does not tiller well. If land is overgrazed it is liable to be damaged by trampling, and in many areas Oat Grass has been so severely weakened that it has begun to die out to be replaced by tufted wiry grasses useless for feeding purposes. These tufted grasses mainly *Pennisetum schimperi* and *Sporobolus pyramidalis*—are in fact in danger of becoming dominant features in considerable areas of East Africa; their presence facilitates erosion because surface run-off water flows between the tufts.

Considerable research has been carried out in Kenya to discover methods of grazing management which will prevent weakening of the Oat grassland and the encroachment of tufted species. Fencing, a first essential action in this regard, was delayed during the war years owing to shortage of fencing materials. The making of hay and silage and the laying down of rich feeding leys are all necessary to supplement the natural grazing so that the Oat Grass may be rested during the critical period. Oat Grass may be cut or grazed without harm when most of the seed has fallen and there is still sufficient succulent matter to provide feed, but if it is grazed or cut during early growth the grass is weakened.

According to D. C. Edwards of Kenya, improvement of Red Oat Grass pastures in higher rainfall areas can be effected by burning off the overgrowth just after the seeding stage. A burn at this time apparently does no harm to the grass, or its re-seeding, and suppresses invading tufted grasses. In drier areas opinions vary as to whether burning is necessary. Burning must, however, always be controlled.

When wiry grasses have invaded Oat Grass pasture they are difficult to eradicate. Even when they have been suppressed, the selective grazing of animals tends to weaken the palatable grasses and encourage the others to strengthen their hold again. Where tufted grasses have become supreme, as has happened in many parts of Bukoba district, it is not possible by grazing management alone to get back good pasture.

Grazing in the marginal country

In marginal country where rainfall is short and badly distributed, grassland in general will not carry an economic burden of livestock without deteriorating, unless great care is taken. Usually leys must be sown to provide additional feeding and the question then turns on suitable grasses for this purpose. A number of exotic grasses have been tried, mostly with scant success, and selection and breeding of ecotypes of the indigenous grasses holds out most promise. Many indigenous grasses have been tested, among them ecotypes of Rhodes Grass, *Chloris gayana* Kunth., have made good leys of palatable persistent herbage. With many indigenous grasses it is difficult to harvest sufficient seed, and even when this has been overcome it is often impossible to obtain good germination and growth without the use of nurse crops. Sorghum has been used successfully as a nurse crop for Rhodes Grass, and it has also been successfully undersown in Maize.

Molasses Grass, *Melinis minutiflora*, P. Beauv., will sometimes make a good ley, and once animals get used to its flavour they take to it readily. It is unreliable, however, and is often attacked by fungoid diseases. This is a pity because Molasses Grass is said to be avoided by parasites such as ticks. Incidentally, a line of research deserving attention is the selection of pasture grasses for their possible deterrent value in respect to animal parasites. A form of Molasses Grass known as the Channia ecotype promises to make good leys when undersown in maize.

Grazing in hot lowland country

In the hotter lowland country where conditions are often semi-arid, indigenous grasses may make luxuriant growth during the wet season. Among them are species of *Cymbopogon*, *Brachiaria*, *Sorghum*, *Andropogon*, *Hyparrhenia*, *Setaria*, and *Eragrostis*. Many are bitter or unpalatable, and will only give scant grazing for a short period after the dense reedy growth has been burnt off. Up to 80% of the seed of most species is usually infertile, and the difficulties in trying to establish any one species are generally insuperable.

The difficulties have now, however, been simplified by the propagation and selection of a hybrid grass known as Kavirondo perennial sorghum.

A single plant similar in appearance to Sudan Grass was noticed near Maseno in the Kavirondo area of Kenya in 1935, from which seed was collected. It was considered to be a natural hybrid between a native grain sorghum and the wild *Sorghum verticilliflorum* Stapf. Initial trials showed that it was a perennial which persisted for a number of years without reduction in yield, and that it produced a prolific crop of viable seed. When the seed is sown germination takes place readily without a nurse crop, so that it is easy to establish a ley.

The plant grows well in warm areas of erratic rainfall, and feeding trials have been remarkably successful. By sowing in drills 2 ft. apart at a rate of no more than 10 lb. of seed per acre, the average yield of green material after 18 weeks may amount to nearly 16 tons. When a field is allowed to mature for seed, the yield of seed per acre amounts to about 350 lb., and though the grain is hardly palatable for human consumption, it has considerable use for feeding livestock.

Since the grass is perennial it has advantages over its nearest competitor, Sudan Grass, and a coarse but excellent sward is produced after the top growth has been cut for silage. Exhaustive tests prove that it does not develop poisonous properties, as is the case with some of the other sorghums.

In Kenya several types of growth and flower head were noticed in the field, and as a result of selection and ' selfing ' a line has been produced which is superior to the original material. It is known as ' R.2S42,' and is more uniform, more leafy and robust. The seed resembles the edible sorghums, so that the new plant may serve the dual purpose of both fodder and grain production. This new type is popularly known as the ' Improved Kavirondo Sorghum.'

Pastures in highland areas

In highland areas where Kikuyu Grass will not grow well, or where it is desired to grow leys from seed, provided the annual rainfall is not less than 40 in., the grass *Bromus marginatus* gives good service. It is a grass with which indigenous clovers will grow in association, and ample supplies of seed are available. The importance of finding grasses suited to every region cannot be over-estimated, for a grass should always be included in rotation with arable crops. Moreover, some grasses are especially useful in improving the physical state of the soil and producing crumb structures; two of these are French Grass, *Cynodon dactylon* Pers. and Star Grass *C. plectostachyum* Pilg., of both of which many types are available.

Other problems

Among other problems which await solution are the control of the encroachment of bush on grazing land, the restoration of a protective cover on land that has become unproductive through overgrazing and erosion, and the damage done to grazing in dry areas by termites. It takes a long while for natural regeneration of perennial grasses to occur in marginal areas, and the first grasses to appear are the invading annuals of poor grazing value. At present these are despised, but the fact that they do arrive and grow in natural succession does give them an importance which should not be neglected. It seems possible that among them may be found useful forms that will quicken the succession towards a more valuable perennial cover.

(A bibliography of publications relating to the subject of this article appears on p. 26.)

[*Photo by Author*

Kikuyu Grass, *Pennisetum clandestinum;* **match box shows comparison of size with runners**

Bulb fields in bloom in the famous bulb-growing area N.W. of Amsterdam

Some Impressions of Farming Conditions in Holland and Belgium

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After the recent International Congress on Soil Science a sixteen days' tour was arranged to enable delegates to gain an insight into farming conditions in Holland and Belgium and to see the various lines of research, especially soil research, in progress. The following impressions have been contributed by Dr. Smith, who was one of the delegates to the Congress.

FROM the point of view of the agriculturist, the Netherlands presents a unique picture. The Dutch have long been recognised as expert in the drainage and reclamation works required to prevent inundation of the large proportion of their country lying below sea or river level. The low death rate and high birth rate have seen the population increase from 5 million in 1900 to 10 million in 1950, so that an extension of the cultivated area has been of supreme importance. The magnificent achievement of completing the Zuider Zee Dam in 1932 allowed Wieringermeer Polder of 50,000 acres to be brought into cultivation by 1940, while the North-East Polder of 120,000 acres is now rapidly being developed and further schemes amounting to the drainage of an additional 380,000 acres of the Ijselmeer are in hand.

Considerable areas are also being reclaimed from the shallow Wadden Sea in the north. This new land is being won at what many would consider to be prodigious cost of some £250 per acre. At the present time, however, the total land area is only about 8 million acres, of which 3.4 are permanent grass, 2.5 arable, 0.6 forest, and 0.3 horticultural. Thus, more than 80% of the land is cultivated and yet there is a serious shortage to meet the demands for food. Small farms predominate; more than 40% of the agricultural holdings are less than 12 acres, while less than 25% are more than 50 acres. Furthermore, many properties have been split in the past so that they are difficult to work economically and a Government service is now engaged upon a scheme of re-allotment.

The average crop yields in the Netherlands are high—winter wheat 22, oats 20, potatoes 180, and sugar beet 300, all in cwt. per acre—but it is a mistake to imagine that this high productivity is due to naturally fertile soils. Rather is it the result of an abundant but controlled water supply, heavy dressings of fertilisers, an excellent educational system and hard work.

There are many points of great interest in making the new soils. For example, the main drainage canals are dredged before the polder is completely drained in order to make use of water transport, the newly drained land being impossible for wheeled traffic. A preliminary survey of the soils is carried out when they are still under water in order to make a tentative classification for utilisation purposes. The reclaimed soils are not always of good quality: the less fertile may be improved by irrigation or by being turned under a more fertile subsoil. The new soils are free from soil-borne plant diseases and every effort is made to prevent these diseases from being introduced into the soils in question. An experimental station at Kampen, under the Ministry of Public Works, is responsible for much valuable research into the special problems relating to reclaimed soils—in particular to drainage, the salinity of soil and water, the inoculation of legumes with bacteria species not present in the new soils in order to meet the large demand for nitrogen, and the best crop rotations to maintain the high initial yields.

In the reclamation of peat land it is regarded as essential to remove about 50 or 60 cm. of the spongy young sphagnum peat or ' bonkaarde ' on the surface and to mix it with the sandy subsoil after excavating the stratified and decomposed layers of peat. The new soil has excellent physical properties and with fertilisers becomes rich arable land.

The Groningen Research Institute

At the Agricultural Experiment Station and Institute for Soil Research, Groningen,

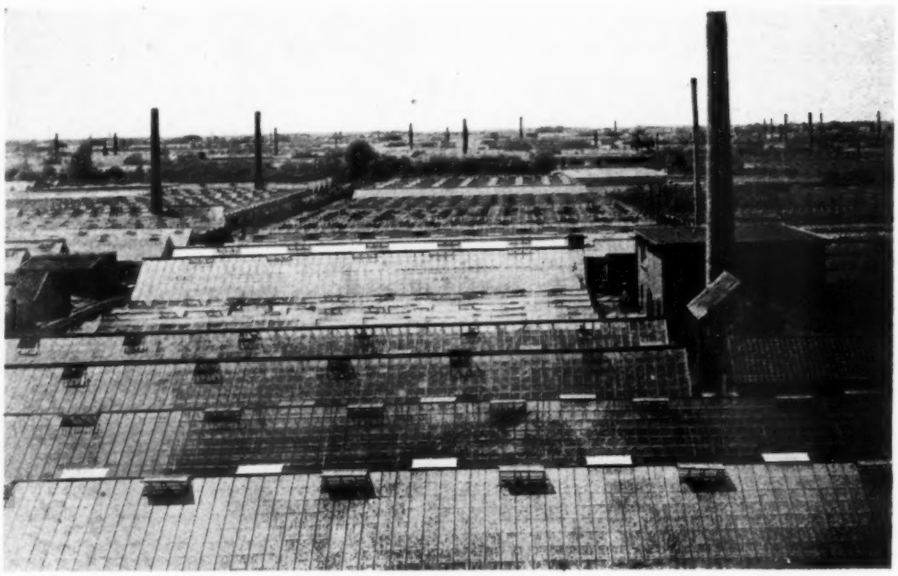
a great variety of investigations is being carried on—the relationships between soil structure and manuring, wind erosion and reclamation; the movement of water to drain-pipe and canal; the organic matter contributed by the roots of grass and arable crops; the influence of molybdenum on the fixation of nitrogen by clover; the parts played by potassium and copper on the tyrosinase and blackening of potato tubers; the biochemical estimation of copper, magnesium and zinc; the mineralogical weathering of potassium and magnesium compounds; the techniques of field experimentation. The chief laboratory for soil testing is at Oosterbeek; this service is self-supporting and the section at Groningen examines 130,000 samples annually. Agriculture is taught to degree standard only at the University College, Wageningen, where a wide range of investigations in the agricultural sciences is in progress. The course occupies about six years, but there is considerable specialisation in the later stages. The Soil Survey Institute is also in Wageningen.

Horticultural soils

Many of the most productive horticultural soils of the Netherlands have been built up by the application of immense quantities of 'slush' dredged from the ditches and in some places these slush soils can be reached only by boat along the drainage channels which have been widened by this frequent excavation. It is interesting to observe that it has been recommended that such fertile and irreplaceable topsoils be transported elsewhere when town development encroaches on their present sites. The intensive horticultural practice in parts of Westland, where over 1,000 acres of tomatoes, grapes, and cucumbers are under glass, is readily apparent from the hundreds of boiler chimneys. Sand dunes have been levelled to make the land suitable for horticulture, the sand being transported by barge to raise and improve the heavy, low-lying silt soils. Early maturing crops can be produced on sand soils but the manuring is heavy; for example, for two successive crops of cauliflowers under glass the application of fertiliser amounted to 350 N, 200 P_2O_5 and 425 K_2O, all in lb. per acre. On the good soils the yields are heavy—of the order of 35 tons of tomatoes and 20 tons of grapes per acre. In this area the growers have founded an experiment station at Naaldwijk (membership 6,400), now aided by Government assistance on a pound for pound basis, to study the problems concerned with the culture of fruit and vegetables under glass.

Sand dune reclamation

The Dutch take great care of the sand dunes along the west coast. In the north an extensive area has been planted—



View of intensive horticultural area of Westland from Naaldwijk

Typical farm steading at Rumsdorp, Haspengouw. Note dung midden and urine tank in centre and farmer's house at back

Austrian pine on the younger calcareous sand, Scots pine further inland where the sand is leached and decalcified. Every precaution is taken against wind erosion, the bare sand often being held in position by 'planting' bunches of reeds until a natural vegetation has fixed the surface. The famous bulb area of Westland is simply a level calcareous sand with the water carefully maintained at 55 cm. below the surface, and blowing is controlled by single rows of a cereal crop sown at intervals of three or four yards across the fields.

Dutch farming

The main river system of the Rhine, Waal, and Maas flows across the centre of the Netherlands from east to west and the soils are largely marine and river clays. The utilisation of the land is determined by soil texture and structure; mixed farming, orchards and market gardens are all to be found. The larger farms of the country, however, are situated in the northern provinces of Friesland and

Protection of sand dune against wind erosion (near Hook of Holland) by planting bunches of reeds

Groningen. There the farmer usually has a villa a short distance from the farm buildings, and the lofty thatched barns are very large—as much as 200 by 75 ft. Elsewhere it is more usual to find the farmer's house occupying one end of the barn building. In the barn itself the animal stalls are placed along the walls while implements, hay and other farm produce are stored in the centre; the floor may be on two levels as a precaution against flooding. In some districts the haystack is built within four upright poles to which pulleys are attached for the raising and lowering of a thatched roof according to the height of the stack.

Conditions in Belgium

The post-congress excursion was extended into Belgium for six days. There soil mapping has been carried out since 1947 from Gembloux to Ghent and Louvain under the direction of a small committee. There are soil maps on a 1:20,000 scale dating back to 1884, which have proved to be of great value as a starting point for the modern more detailed mapping of soil series and types. The State Agricultural Institute at Ghent was founded in 1922 as a centre for agricultural teaching and research, the buildings being notable for their admirable design.

From Ghent it was possible to see something of a great variety of soils, including the alluvial plain of the River Scheldt, so wet as to be devoted almost exclusively to grass; the sandy regions around Ghent and in the 'Land of Waas' where the soils are of little value for agricultural purposes, but have been so changed by man that intensive floriculture can be practised with the aid of sprinkle irrigation for 80 to 100 days in the year (the so-called 'Garden of Flanders'). Sands have been made fit for wheat and sugar beet by adding clay excavated from the subsoil, and in South Flanders there are sandy-loam soils in which perched water tables, due to impermeable layers, exert a great influence upon the agricultural value of the land.

Between Louvain and Liége the excursions were designed to show the relationship between the different classes of soil in the loess region and their relative values for agricultural and fruit crops; generally speaking, sugar beet and cereals grow best on the *terra-à-brique* soils while, although the dry alluvial soils are good for fruit, the best orchards in Belgium, especially pear and cherry, are also on *terra-à-brique*. The deep excavation of the Albert Canal in the chalk formation at Vroenhoven and the alluvial plain and terraces of the River Meuse were also interesting features of the route followed.

In the Liége area the market garden soils have been built up from the debris of the coal mines in the neighbourhood. In the Condroz region south and west of Liége the topography is characterised by long parallel hills resulting from the differential weathering and erosion of the alternating layers of schistose sandstones and carboniferous limestone. The soils vary considerably in physical and chemical properties and mixed farming predominates. Near Namur an opportunity was presented of examining the soils of the ancient forest of Marche-les-Dames lying on carboniferous limestone, often dolomitic; large parts, however, are covered with heterogeneous deposits and this has given rise to a great variety of soil types and plant associations.

(Photo p. 11 by K.L.M. Royal Dutch Airlines.)

Tonkin Canes and Rattans

Concluded from p. 7.

Generally speaking, however, such rattans are more brittle and inferior in strength and preparation to those received from the Far East. One reason for the brittleness may be due to the fact that they are often harvested before they are mature. The pliability of rattans depends on the number of fibre bundles arranged around the wood and the structure of the individual fibres. Sclerenchyma fibres with strong thick walls and small lumena give greater resistance to the stem than those with thin walls and large lumena. Where the sclerenchyma have not reached their full development, as when rattans are harvested before maturity, the rattans tend to be brittle. Another disadvantage with some African rattans is that they are often tapered, although it does not seem to have been established whether this is due to the species, growth conditions or the fact that they are shorter and the taper is consequently more pronounced. Now that rattans from the Far East are beginning to come forward again the demand for them from other sources appears to be declining.

BIBLIOGRAPHY

F. A. McCLURE: A New Species of *Arundinaria* from Southern China. Part 2, Notes on Culture, Preparation for Market and Uses. *Lingnan Science Journal*, **10**, Nos. 2 and 3, 295-306.

J. H. VAN TUIL: Handel en Cultuur van Rotan in de Zuideren Oosterafdeeling van Borneo. *Tectona*, **xxii**, 695-714, 1929.

C. VAN DE KOPPEL: De Handel in den Ned. Indischen en het gebruik er van voor verschillende industriëele doelinden. *Tectona*, **xxii**, 1213-1248, 1929.

L. H. BURKILL: A Dictionary of the Economic Products of the Malay Peninsula, pp. 1860-1885.

ANON.: Rattan Industry in Shanghai. *Chinese Economic Bulletin*, **xiii**, No. 10, 122-124, 1928.

F. W. FOXWORTHY: Palms and Palm Products. 1. Rattan. *Malayan Forest Records*, No. 2, 153-158, 1922.

H. N. RIDLEY: Rattans. *Agricultural Bulletin of the Straits and Federated Malay States*, **ii**, 129-136 and 157-160, 1903.

ANON.: Breuk in Rotan. *Koninklijke Vereeniging Kolonial Instituut Amsterdam*. Mededeeling No. XLIX, Afdeeling Museum, No. 20, 1939.

S. RAMASIVAMI: Indian Canes (Rattans). *The Indian Forester*, **76**, No. 4, 159-163, 1950.

(Photos: Messrs. Jacobs, Young & Westbury Ltd., London.)

CORRESPONDENCE

Mechanisation on Small Farms in the Tropics

TO THE EDITOR

Dear Sir,

In considering the mechanisation of small farms in the tropics, your eminent contributor, J. E. Mayne, B.Sc.,* Imperial College of Agriculture, Trinidad, arrives at the sound conclusion that nothing smaller than a medium power-wheel tractor comes near to satisfying requirements. This is surprising, however, in view of the misconceptions which he puts forward at the beginning of the article.

For example, he points to the lack of dung when animal power is displaced. Properly deployed, a tractor of 23 b.h.p. will perform the work of up to five draught animals. The land thus freed will keep a larger number of livestock for meat, milk, wool or egg products. As a result of better cultivations, an improved standard of nutrition should be available to such livestock and the greater quantity of dung produced will certainly be of better quality. Alternatively, the tractor provides improved facilities for green manuring or for use of fertiliser.

It does not matter whether the wage of the worker be one penny or 30 pence a day, his potential output must be raised if his standard of living is to improve in keeping with current thought and demand. If output does, in fact, go up fourfold as it should, the resulting produce must be cheaper if only because of greater volume. Since food is the first essential of life, the alleged expense of mechanisation is more than counterbalanced and the equipment is capable of the same output for many years. In fact, output usually rises as experience is gained.

Fuel, lubricants, repairing parts, etc., can be hauled by the tractor if sound principles of provisioning are applied. Indeed, there are no valid technical reasons why a tractor should not grow its own fuel. At eight tons an hour, four acres of potatoes will provide sufficient alcohol for one thousand hours' work.

Your contributor points to the breeding capabilities of draught animals, but it will always cost something to breed animals and there are many attendant risks. Moreover, breeding is usually at the expense of work. Depreciation takes place whether mechanical or animal power be used. It is only the incidence at certain ages which varies and this emphasises the relative uselessness of the immature draught animal.

With regard to difficulties of terrain and climatic conditions, it is quite certain that a well-designed tractor, with implements designed properly to exploit it, will go anywhere that draught animals will work. It will work in many places where a horse cannot and with much less hardship from heat, flies or dust.

Mr. Mayne's figures and his conclusions concerning the draught of certain operations are interesting, but they tend to ignore the fundamental consideration that the first requirement of mechanisation is to increase output per man and per acre. Many years of experience have shown this is achieved most economically by a light tractor of 23 b.h.p. with hydraulically-controlled implements so mounted that they provide necessary weight for traction in proportion to the load.

Yours faithfully,

For Harry Ferguson Limited,

A. B. LEES, Economic Research Manager.

Coventry, November 1, 1950.

We passed a copy of Mr. Lees' letter to the author of the article from whom the following reply has been received.

TO THE EDITOR

Dear Sir,

I am grateful to have the opportunity of replying to the letter from Mr. A. B. Lees of Harry Ferguson, Limited.

Your correspondent's views of the tractor's dung-producing capabilities surely point to lack of understanding of small-scale farming in the tropics where draught animals are usually maintained on weeds and grass cut from roadsides, fallow or waste lands. The conception of growing feed for animals is not universal. The tractor does, of course, provide improved facilities for green manuring—and many other agricultural practices, good in the temperate regions, whose economic and cultural values in the tropics are not yet fully known.

The significance of Mr. Lees' remarks on productivity pass me by. Whatever factors counterbalance the expense of mechanisation, cost still remains the ruling factor. His plea is for the men of the tropics, by mechanisation, to produce more and yet more food; but is it not perfectly valid, in many territories, to ask how and why? We must not assume that our European conceptions of production are necessarily acceptable, or applicable.

I would not deny that means can be found to cope with problems of maintenance, supplies and fuel. An airlift could, for example, keep a thousand tractors working in the bush—on alcohol distilled from bananas—but we must be practical.

I feel that perhaps I am picking at Mr. Lees unfairly, because we must have totally different ideas of what constitutes 'farming.' This is especially evident in his remarks about the breeding of animals, and the tractor work in difficult terrain. To counter Mr. Lees: it is quite certain that there are many places where draught animals are constantly used for work under conditions in which any light tractor could not do the same work. To enlarge upon this would involve the writing of another complete article.

I am wholeheartedly with Mr. Lees in his desire to increase both the productivity of tropical acres and the output of small tropical farms. This is, as he says, the fundamental consideration. But I disagree that many years of experience have shown that the use of any tractor is the most economical means of doing this.

To look on the gloomy side: what response would we expect from mechanisation in an area where fertilisers are seldom applied (even by hand); where dung is burned; where crops are grown—usually for very sound reasons—in mixed culture, seldom in rows, often on mounds; where weeds can grow eight feet in two months; and where the land may be all but waterlogged for weeks on end? We are struggling to reach Mr. Lees' plane of agricultural thought, but we still have a long way to go.

Yours sincerely,

J. E. MAYNE.

The Imperial College of Tropical Agriculture, Trinidad, November 16, 1950.

* See article in the November 1950 issue of WORLD CROPS, 'The Small Tropical Farm and Mechanisation', by J. E. Mayne, B.Sc.

Malayan Pumping Scheme

An irrigation project, known as the Salor Pumping Scheme, which it is estimated will cost £25,000, is to be introduced by the Kelantan State Government, Federation of Malaya.

The scheme will serve as a 'pilot' for the Kelantan Plains Irrigation Scheme. It is expected to increase the yield of dry padi and also to permit planting of wet padi.

The Salor area includes some of the best padi land in the State. Water will be drawn from the Kelantan River by pumps supplying 786,000 gallons per hour.

Ploughing in an Elburz valley, near Tehran

Agriculture in Persia

Persia is predominantly an agricultural country, and notwithstanding the fact that it has assumed prominence by the discovery and development of its oil resources, it is bound to remain so. Agricultural methods are still much the same as they have been for thousands of years, and improvement in the agricultural position must be a prime consideration if living standards are to be improved. To achieve this the Persian Government have formulated a seven years' development plan. The following account of the circumstances of agriculture is reproduced by permission from an article in 'Great Britain and the East' by Mr. Charles Holland.

THE total area of Persia is 650,000 square miles, of which it is estimated that between 10 and 15% is under cultivation. Of the remainder it is considered that from 20 to 30% has potentialities for agriculture provided there is adequate expansion of irrigation facilities. Grazing land accounts for a further 15%, forests for 10 to 15%, while desert and unutilisable waste land represent 30 to 35%.

Agricultural methods have changed but little during the centuries and those practised during Biblical times still remain largely in evidence. Obviously, therefore, improvements in this regard must play a leading role in attempts to raise the standard of living and to improve the lot of the ordinary citizen. Before the last war great efforts were made to develop industries, but so far, out of a total population of 16 to 18 millions, only some 200,000 are engaged in industrial pursuits. The existence of large estates has to some extent acted as a brake on progress and of recent years there has been considerable development of small holdings, but the introduction of better methods, including notably the expansion of mechanised farming and the extension and improvement of irrigation, is essential if substantial progress is to be achieved. Hitherto the peasantry have shown a tendency to be hostile to innovations, especially in the south, and before there can be any real advance it will be necessary to overcome this and to educate them to the advantages that can be derived from the employment of modern agricultural methods.

Agricultural conditions

The varied character of the agricultural products of Persia reflects the wide variations in soils, climates and rainfalls. Thus in the Caspian zone, where the rainfall may exceed 50 in., there is fertile alluvial soil. But in the vast central plateau the rainfall may be no more than 2 in., while in the Persian Gulf area the average rainfall is about 12 in. Similarly temperatures vary from 122°F. in the central area to as low as 4°F. elsewhere. So the products range from tea grown in the Caspian region to plants which can survive in extreme cold.

Cereals

Wheat is the principal cereal crop, the average production being about 2,250,000 tons, which is not equal to home requirements. While wheat is grown in many parts of the country, the principal areas are in the provinces of Khurasan, Azerbaijan, Kermanshah, Khuzistan and Fars. Barley is also grown in these areas, the average yield being about 1,500,000 tons.

The yield of these crops is dependent on the irrigation facilities. In the irrigated areas water is obtained either by gravitation from rivers or by artificial subterranean channels. In the unirrigated regions great importance attaches to the rainfall occurring at the right period. If the rains occur from February to the beginning of April then all is well, but if the rainfall is between November and January, followed by a dry spell, the result is a crop failure. The records show that for a period of 11 years in the Persian Gulf region the average is only one good crop and two or three medium ones. That illustrates one angle of the problem that has to be faced.

Rice is grown in the Caspian provinces of Gilan and Mazanderan. It is cultivated in other areas where there is irrigation, but the yield in these two provinces constitutes more than four-fifths of the total production. Before the war the average area under rice was about 540,000 acres, the yield being approximately 470,000 tons. The area was increased during the war, but there was a falling off in yield. Subsequently there has been a recovery, and for 1947 the production was 420,000 tons, of which a considerable amount was exported to Russia.

Tea

Tea is cultivated in the neighbourhood of Lahijan on the Caspian shore, the production at present being about 4,000 tons. This is nowhere near enough to meet internal consumption, but the yield is increasing, and it is thought that there is considerable scope for the expansion of the crop. It is believed that the area between the cities of Ramsar and Astara and that between the mountains and the Caspian Sea, amounting to 8,000 hectares, can be added to the land already under tea cultivation. This would mean that the production of tea would be more than doubled and on the present basis of consumption Persia would be almost free from dependence on imports.

Sugar and cotton

Sugar beet provides nearly all the sugar at present produced in Persia. The production ranges from 30,000 to 40,000 tons annually, or approximately one-third of the domestic consumption. Centuries ago, before invaders destroyed the irrigation works, sugar cane was extensively cultivated, and there was an important export trade. It is thought that this cultivation could be resuscitated, and provision for this is made in the irrigation plans to which reference is made later.

Before the war cotton was an important export crop. It is grown in most parts of the country, but the area has declined in recent years and, while at one time the output was as much as 30,000 tons, the production in 1947 was no more than 14,000 tons. A shortcoming of the crop has been its short staple. Efforts have been made to remedy this by introducing an American variety into Khurasan and by testing American cotton from Iraq in Fars. It is thought that the Persian Gulf region offers the best prospects for the long-staple type.

The importance of attention to this cultivation is shown by the fact that Persia has to import cotton for her considerable textile industry.

Silk, tobacco and oilseeds

Silk production has passed through many vicissitudes. Up to about 1860 the total output amounted to around £1,000,000. Then there was a decline, until at the end of the last century silkworm eggs were imported from Turkey and elsewhere. The yearly crop is now in the neighbourhood of 1,500,000 lb., of which rather more than one-third is exported.

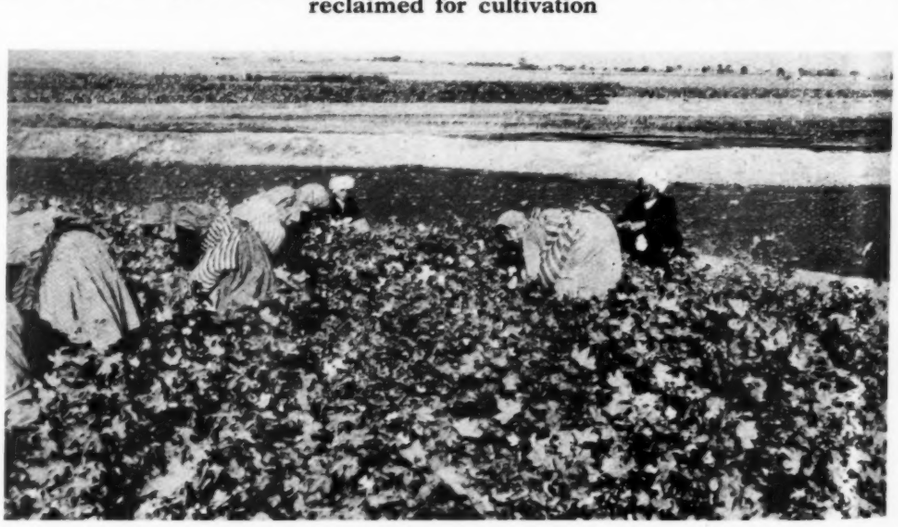
Tobacco is grown in many regions, but particularly in the valleys leading to the Caspian. The area now devoted to the crop is about 30,000 acres, the yield being approximately 10,000 to 14,000 tons. The produce meets the requirements of the Government tobacco factory in Tehran, the production of which averages 12,000,000 cigarettes a day. At present the Government Monopoly has to buy all the Persian tobacco offered to it and, as pipe tobacco is produced in larger quantities than are required, the Monopoly loses on this item. It is proposed that it should no longer be necessary for the Monopoly to take all tobacco available, the idea being that this would tend to restrict the crop to types for which there is an adequate demand. The construction of curing sheds and warehouses is also advocated with a view to the improvement of the quality of the tobacco.

Oilseeds play a fairly important part in the agricultural output. Apart from cotton seed, castor oil and sesame are outstanding crops.

Fruit cultivation

Fruit cultivation and the preparation of dried fruits occupy a high place in Persia's agriculture. The fruits grown include melons, oranges, dates, grapes, plums, raspberries, apples, pears, pomegranates, cherries, mulberries, figs, almonds, peaches, apricots and strawberries. This wide range

Tomato plants growing in once salt-laden ground near Abadan, which has been reclaimed for cultivation



Cotton picking near Sabzauar, N.E. Persia

Left, **Grain harvesting is still carried out by hand sickle and** (*right*) **winnowing is effected by the simple method of allowing the breeze to separate chaff from grain ; photos taken near Tehran.** *Centre*, **Ricefield and thatched building in the Caspian province of Gilan, near Resht**

of products illustrates the fact that the Persian climate is particularly suitable for fruit production. The output of grapes averages about 550,000 short tons annually, while that of dates is about 132,000 short tons. Raisins, dates, dried fruit and almonds constitute important export items.

Stock raising

Stock breeding is a principal occupation of Persian peasants. The animal population is estimated (in thousands) as: sheep, 15,451; goats, 6,954; bulls, 1,324; cows, 1,142; draught cows and oxen, 194; donkeys, 1,150; horses, 1,843; camels, 75. Despite the large flocks of sheep, the production of wool is insufficient to meet the needs of the wool spinning and weaving factories, and considerable quantities of American wool are imported to eke out the supplies of the coarser native product. The immediate need is to improve the breed of sheep and other livestock by the import of superior strains.

Some basic needs

Such in brief outline is the agricultural position in Persia at the present time. The programme for its improvement is comprehensive and logical. In the first place, it is stressed that the production of the present cultivated area must be increased by improvements in agricultural methods. Thus a plough must be used which really turns the ground over and buries any vegetation. It is held that in Khuzistan Province, for example, where native perennial vegetation has been untouched, this would mean an increase in crop yields of from 35 to 40%.

The construction of water distribution systems on irrigated land is listed as another essential. Concurrently it will be necessary to level much irrigated land to permit the even distribution of water. The position now is that while some fields have been over-irrigated others have received little or no water. There is also a need in a number of areas for the construction of drainage systems to deal with surface and subsurface water.

Methods of planting, such as the establishment of a crop rotation system and the planting of crops at the best date after making proper preparations, and the improvement of soil fertility by means of manures, fertilisers and crop residues, are other matters which call for attention. It is stressed that agriculture must be mechanised as soon as possible in dry land grain areas and in irrigated valleys where there is a small population. The mechanical equipment needed includes tractor-drawn ploughs, tractor-drawn seeding and planting equipment, land-levelling equipment and cultivating equipment.

Outstanding problems

A serious problem is presented by wind erosion, which has worked havoc in Persia in the past, as shown by the numerous cities which have been buried. Yezd is an example, while today the city of Kerman is threatened. It is suggested that this danger can be checked by the establishment of windbreaks, consisting of rows of trees and shrubs.

Then there is the waste that goes on in the present agricultural production because of the lack of storage facilities and adequate communications. Allowing for the utilisation of the full storage capacity, the total available is only 170,000 tons, or about 10% of the wheat production.

Several factors are involved in efforts to stimulate the production of meat, wool and other livestock products. Prevention of over-grazing, for instance, would bring about a greater production from fewer animals. It is considered that steps should be taken to limit unchecked grazing by goats, which in Persia as in other countries do much damage to agriculture. Then there must be a systematic programme for the improvement of breeds of livestock. Thus because the sheep breeds are of inferior quality the output of wool is not only low but it is generally of poor quality. Slaughter houses and packing plants will have to be constructed in the livestock-raising regions to prevent the loss in driving livestock long distances to meat-consuming centres.

Possible new products

An important facet of the improvement of agriculture in Persia is the introduction of new products. There are a number of plants, the products of which are in short supply on the world markets, which could be cultivated to advantage. Flax is a case in point. There is a great shortage of its products, linseed oil and linen, and the plant, which could be grown in many parts of Persia, should not only prove a most remunerative crop but might lead to the establishment of a linen industry. The soya bean, needed for the paint and plastic industries, would be another extremely useful crop. Then the tung tree could be

introduced to advantage, as there is a great demand for tung oil. The three products mentioned illustrate the prospects in this field. In addition there are, as already indicated, extensive possibilities for the extension of existing cultivations.

Irrigation developments

Irrigation is the fundamental problem in connection with the development of Persian agriculture. Unless it is tackled effectively all the planning in the world would be of no avail. Naturally, therefore, irrigation projects figure prominently in the schemes for agricultural reorganisation. There are at least 25 major irrigation plans and, while it is impossible within the scope of this article to examine them in detail, a few of the outstanding projects will give some idea of the thought that has been devoted to the question of water supply.

Typical of the plans in view is the project for the irrigation of the Veramin Plains, an area of approximately 100,000 hectares of good agricultural land situated 40 kilometres to the south-east of Tehran. While the area has excellent communications and is within easy reach of the leading centre for agricultural produce, developments have been restricted by the lack of irrigation. The average rainfall in the area is no more than 9½ in. and, while the Jajarud River flows from the Elburz Mountains to the Veramin Plains, it is estimated that no more than a sixth of the agricultural area receives irrigation.

It is proposed to build a dam and reservoir at Latiyan, which with the necessary ancillary works, such as a main canal and a distribution system, would provide irrigation for the area. The effect would be to transform the Veramin Plains into a thriving agricultural region, producing valuable crops of wheat, barley, sugar beet, and so on.

Another oustanding project is that for Shushtar on the Karun River some 50 miles north of Ahwaz. Minab-Sushtar Island, as it is called, has a total area of about 110,000 acres, and contains one of the most fertile regions in Khuzistan.

Because of the climate and the general conditions it is held that the area is particularly suitable for the production of sugar cane, and it is thought that concentration on that product will make Persia self-sufficient as regards sugar supplies. In the past a dam was constructed across the Shottaite River to control the flow of the Karun River and to enable water to be diverted to the local flour mills. It is proposed to erect a concrete structure on the site of the former dam and to establish a distribution system to serve 100,000 acres on the island. According to the schedule of development it will take nine years for the project to be in full operation.

There is another interesting project in the same region, near Hamidieh village some 30 miles north-west of Ahwaz. In this area there are remains of ancient irrigation systems, but the land is not now generally irrigated. An agricultural company is irrigating some 1,500 hectares by pumping from the river. It is proposed to construct a dam on the Kaikheh River about 10 miles upstream from the Hamidieh pumping plant to raise the river level by 12 ft. There would be headworks to control the flow into a main canal, and a distribution system would permit the irrigation of the land, much of which will need to be levelled if the scheme is to be successful.

This summary will suffice to show the immense task involved in agricultural reconstruction in Persia and the efficient way in which the plans have been drawn up. It must be emphasised that in the best circumstances the development of the country's agriculture will be a long-term business.

In concentrating on improvements in agriculture, the general advantage to Persia's economy is sufficiently obvious to need little emphasis. The consequences of an increased area under cultivation, higher crop yields, improved livestock and modernised fruit cultivation, will be much higher returns for agriculturalists and, as a sequel, a much increased purchasing power. That will mean a rising demand for commodities and for goods that had hitherto been outside the reach of the majority. Thus, industry will be given a great fillip, for it is in accord with economic theory that a buoyant home market will stimulate manufactures.

That is one consequence. But the process goes further than that. Progress in agriculture implies the expansion of communications, for if new areas are to be opened up efficiently and increased crops are to be dispatched promptly to the markets there must be adequate road and rail facilities. It will be seen then that the various facets of Persia's economic fabric are closely linked together, and it is because agriculture is the fundamental basis of the country that the improvement of cultivation is the basic key to the general scheme for a reorganised economy.

(Photo p. 16 (top), Anglo-Iranian Oil Co., other photos by Laurence Lockhart, B.A., Ph.D.)

£1,000,000 Endowment by Nigerian Cocoa Board

The Nigerian Cocoa Marketing Board has contributed £1,000,000 to help endow the Department of Agriculture at University College, Ibadan. The Chairman of the Board, Sir Sidney Phillipson, states that the fund is to be used for the advancement and in the interests of the whole cocoa farming community of Nigeria.

The only condition attached to the gift is that the income is to be spent entirely on the College's department of agriculture. The Board is to establish a trust to administer the fund and will also set aside £50,000 of the grant for initial expenditure on agricultural buildings and equipment. This will help to ensure that the agricultural department is made into one of the best equipped schools of tropical agriculture in the world.

Current expenses for a period of five years have been guaranteed by an annual grant of £100,000 from the Nigerian Government, which is also making an initial grant of £250,000 to the College Endowment Fund.

Refined Petroleum Oil as an Insecticide

E. R. de ONG, Ph.D.

In a previous issue of this journal there appeared an article reviewing generally the numerous applications of petroleum oil to agriculture. Of these none is more striking than the extended use which petroleum products have attained in controlling insect pests of crops and particularly pests of fruit trees. In the U.S.A. great advances have been made with this application during the last few years, and in the following article the present position is described and the limitations to the use of the various types of oil discussed.

THE use of petroleum oil as an insecticide began about 1865 when kerosene emulsion first came into use. If this kerosene is emulsified with soap, it can be used against aphids and other susceptible insects, but is ineffective on resistant types such as most scale insects. In the effort to find cheaper and more toxic oils, use was made of the fractions known as ' stove distillates ' of 26° to 32°A.P.I. (a specific gravity index similar to the Baume scale). Such oils are better insecticides but are not tolerated by the plant. Crude oils from an asphaltic base were then tested as dormant sprays against the more resistant scales of apple, pear and prune trees, but again the intolerance of the plant restricted their use.

In 1914 the study of petroleum fractions was begun at the California Agricultural Experiment Station, in an attempt to find an effective and cheap petroleum insecticide that would be largely free from hazard to the plant. The demand for such a product was intensified, firstly by the need to find a satisfactory means of control for the mites (red spider and other forms), which attack almost every type of orchard tree and many shrubs and ornamentals; and secondly, by the need for an efficient substitute for hydrocyanic acid fumigation of citrus trees. Throughout the world, wherever citrus trees are grown in semi-arid districts, HCN, as it is commonly known, is the usual control agent for scale insects. However, resistant types of scale insects began to appear and an effective substitute was needed to keep the citrus groves in production.

These demands led naturally to a study of petroleum fractions because of their low cost, world-wide availability, and particularly the large quantities of oil fractions between kerosene and the true lubricants for which there was but a small market. These fractions range in viscosity (Saybolt at 100°F.) from 40 to 120 Saybolt seconds and have a distillation range from 565° to 720°F., and are of little value as lubricants. A relation was established at the California Experiment Station between the composition of the oil and plant tolerance, and this has now been so perfected that many millions of gallons of this type of oil are used annually as insecticides and as carriers for more toxic chemicals.

Composition of petroleum oil and the relation to plant tolerance

Crude petroleum oil is a mixture of various organic compounds in which may be dissolved small amounts of sulphur. When refining it sand and water are first separated and then by distillation it is broken up into various fractions. These include lower boiling-point compounds such as xylene, naphtha, gasoline and kerosene, higher boiling-point fractions which comprise the lubricants, and finally tars, asphalt and naphthalene. The distillates are themselves mixtures of organic compounds, and include both saturated and unsaturated compounds. The principal saturated constituents are paraffinic and naphthenic compounds, while the unsaturated constituents include olefinic and aromatic compounds. Separation of the saturated and unsaturated compounds is effected by treating the distillates with concentrated sulphuric acid or by dissolving out the unsaturates by treating with liquid sulphur dioxide. A definite relationship has been established between the unsaturated compounds present and plant tolerance. Since the sulphuric acid com-

Winter spraying of crimson Bramleys, employing hand brooms for the job. Where a really thorough cover is essential, as with winter washes, automatic spraying is not used

bines with these and leaves unaffected the saturated compounds (paraffins and naphthenes) the total amount of the latter is spoken of as the ' unsulphonated residue,' and the determination and specification of this forms the basis of the present widely expanded consumption of refined petroleum for plant spraying.

Specifications of petroleum distillates and their significance

Petroleum fractions marketed for specific purposes are graded on certain characteristics, which may be either physical or chemical. Lubricating oils are largely defined by their density or specific gravity (Baume or A.P.I.), flash point, colour, and viscosity. These, however, either alone or together, were found to be inadequate for defining oils for use in spraying plants, and it became necessary to develop special specifications for oils to be used in horticulture and agriculture to enable refiners to produce acceptable forms.

Density

Generally speaking, the saturated hydrocarbons are of lower density than either olefins or aromatics, and accordingly density provides some indication of the type of crude oil from which a particular product is derived; taken in conjunction with other factors, it helps to give some idea of the structure of the molecule. It also serves to distinguish between the volatile kerosenes and the non-volatile lubricating oils, but taken alone it cannot be used to define spray oils since, for example, a highly refined white oil with an unsulphonated residue of 98% may have the same density as a gas oil with an unsulphonated residue of 55%.

Unsulphonated residue

As explained above, this refers to the separation of the saturated hydrocarbons from the unsaturated hydrocarbons by treatment with sulphuric acid. The refining of lubricating oils is seldom carried beyond the point when the unsulphoned residue amounts to 55 to 60%; this involves the use of relatively small amounts of sulphuric acid, with corresponding moderate loss of treated oil in ' acid sludge.' The treatment of an oil to raise it to an unsulphonated residue of 90 to 98%, however, requires a much larger proportionate amount of sulphuric acid with a correspondingly large loss of the original distillate as acid sludge. Moreover, excessive treatment with sulphuric acid always entails the possibility of breaking down the molecular structure of the distillate, and this makes the use of the lighter oils with unsulphonated residues of 90 to 92% desirable for spraying preparations. Light oils with viscosities of 55 to 70 Saybolt seconds have to be subjected to less violent treatment with acid, and for most purposes such oils with unsulphonated residue of 90% are considered safer than the heavier and more viscous oils even though they may have higher unsulphonated residues. This is discussed further under *viscosity*.

Until this test was developed, very little use was made of petroleum for spraying, and the adoption of the sulphuric acid refining process and the use of the unsulphonated residue value as a criterion has enabled the utilisation of low price and widely distributed petroleum distillates in crop protection, not only as direct insecticides but also as carriers for other toxic insecticides and fungicides.

Viscosity

This is a measure of the rate of flow of an oil and is related to its molecular structure. It is of value as a means of comparing oil derived from the same or adjoining oil fields; and coupled with the distillation range, it forms the basis for classifying Western United States spray oils. It is not applicable, without modification, to the paraffinic oils of the Eastern United States.

Viscosities of insecticidal oils, as well as lubricating oils, are commonly stated in the United States of America, in terms of the Saybolt Universal Viscosimeter. The readings are in seconds of flow at 100°F. Viscosity and volatility are related but are not coincidental. The variation between these two specifications is quite noticeable in comparing the oils of Western and Eastern United States. Viscosity may change materially during refinement while the volatility remains constant.

Viscosity varies very considerably with changes of temperature, even with these commonly encountered when spraying in the field. An oil with a Saybolt viscosity of 60 sec. at 100°F. may change to 146 sec. at 50°F. and to 48 sec. at 120°F. One of 98 sec. at 100°F. may be 780 sec. at 40°F. Hence dormant spray oils are largely used at 90 to 110 sec. Saybolt. If more viscous oils are used at 40° to 50°F. they become waxlike and incapable of coverage.

One of the most important factors relating to viscosity is the difference in penetration and translocation within the leaf. The more viscous oils of 80 to 100 sec. Saybolt penetrate very slowly into the breathing pores (stomata) of leaves and when they do penetrate it is very difficult for them to be dislodged or translocated by the sap stream; oils so fixed may interfere with the normal functioning of the leaves or fruit. Lighter types of oils (50 to 60 sec. Saybolt) penetrate more readily but are transported in the sap stream as tiny globules of oil and stored in other parts of the plant where they cannot interfere with normal functioning.

The value of kinematic viscosities* and the viscosity index†, together with the refractive index and the aniline point are being studied by the New York Agricultural Experiment Station, Geneva, New York, in relation to the insecticidal value

*A.S.T.M. D445-39T.

†A.S.T.M. D446-39. American Society for Testing Materials, 1911 Race Street, Philadelphia, Pa., U.S.A.

Orange tree showing dead wood in the portion sprayed with a petroleum oil having an unsulphonated residue of 56%. The normal condition of the remainder of the tree is typical of applications with refined oils (unsulphonated residue 92%)

Prune trees injured by a broken emulsion made with cresol soap. The spotted condition as shown by the adjoining trees is characteristic of this type of injury

of different types of petroleum oil. Their findings to date indicate the greater efficiency as insecticides of oils of a paraffinic character.

Distillation

The specifications commonly used in Western United States and Canada for spray oils include distillation range as well as viscosity and unsulphonated residue: the quantity and density of the fractions distilling over at stated temperature ranges are useful indices of quality. Distillation is associated with volatility, but the two are not synonymous and boiling points alone are undependable as they vary with the chemical nature of the fraction.

The official California regulation‡ for classifying western spray oils is as follows:

FOLIAGE SPRAY OILS

Grade	Per cent. Distilling at 636° F.	Unsulphonated Residue
Light	64 to 79	90
Light medium	52 to 41	92
Medium . .	40 to 49	92
Heavy medium	28 to 37	92
Heavy . .	10 to 25	94

Dormant spray oils have the same distillation ranges but lower requirements for the unsulphonated residue. If spraying is delayed until the buds are opening, however, the foliage type of oil must be used.

Oxidation

The possibility has long been recognised of producing small amounts of organic acids injurious to foliage when spray oils are exposed in thin films to the action of sunlight and oxygen. The development of acidity may occur in oils of varying unsulphonated residue and it may also be increased by adding small amounts of aromatics dissolved from petroleum with liquid sulphur dioxide. This hazard is generally recognised by oil refiners and careful attention has to be given to selecting oils of a stable type that resist oxidation changes. The addition of chemicals that act as oxidation inhibitors in the spray oils is another method of meeting this difficulty. A process which has been used successfully, especially where pine oil is present, is first to treat the oil in such a way that it develops as much acidity as possible and then subsequently to neutralise this with alkalis. Incidentally, this method makes possible the use of pine oils in spraying oil which otherwise would be impracticable.

Volatility

This factor is of minor importance in the selection of oils as the effect is largely included in the distillation range. The main difference between kerosene and the lubricating types of oil is its volatility; kerosene is of limited insecticidal value because of its extreme volatility, but even the lightest of the lubricant types of oil used as plant sprays is practically non-volatile.

Sulphur

This element when present even in small amounts in a spraying oil may be injurious; it must be removed by refining before the oils can be used for spraying. Its removal by appropriate treatment accordingly forms a part of refinery practice.

Emulsions and emulsifiers

An oil emulsion is one in which the oil is broken into small globules, each of which is surrounded by a film of the dissolved emulsifier. This film may be tough and elastic, forming and holding small droplets of oil as occurs when sodium-fatty acid soaps are used as emulsifiers. Two types or rather degrees of emulsification are used in spray practice; the first is stable and quick-breaking emulsions which may interblend without any definite line of separation. They depend (*a*) on the emulsifier used, (*b*) on the ratio of emulsifier to oil, (*c*) on the vigour of agitation, since this controls the breaking up of the oil into fine particles, (*d*) the type of oil involved, and (*e*) the character of the water used for dilution. These points are for many situations in the above order of importance, although a very hard water may require first consideration.

The second type forms large oil globules which unite rather easily and on standing may form free oil. An example of the latter emulsifier is the calcium-casein mixture. A third form of emulsion, known as the ' mechanical mix,' is made by breaking up the oil globules by the action of a mechanical agitator or by forcing the liquid through a small orifice in a spray nozzle. The ' mechanical mix ' breaks when the agitation ends, which causes an uneven application of oil and the diluting water. It is not a true emulsion.

Sodium soap base should not usually be the principal emulsifier, except in regions where water is very ' soft ' and dissolved calcium and magnesium salts are largely lacking. Cresylic acid-sodium soaps are used in making the ' miscible ' types of emulsion (a very stable form); if, however, they are broken the cresylic acid separates as a distinct layer and may injure or even kill trees; an example of the effects of this is shown above. Much care should be used in districts where emulsions are being marketed for the first time to insure that they have the right degree of stability.

In addition to the danger of hard water causing broken emulsions, improperly-made emulsions may ' layer ' in the drum, that is a heavy concentration of emulsifier forms at the bottom of the drum thus forcing much of the emulsified oil to the top. Since it is very difficult to break up such layers in the field, it usually results in drawing off emulsion for one tank load from the layer with excess emulsion, and a corresponding deficiency of emulsifier in other tank loads. Excess emulsifier in a spray fluid results in heavy run-off in application with corresponding loss in insecticidal efficiency. The amount and choice of emulsifier for commercial emul-

‡California State Dept. of Agriculture, Special Publication No. 192 (1941).

sions should be determined by ensuring stability on the one hand and the highest value as an insecticide combined with plant tolerance on the other. ' Tank-mix ' emulsions are satisfactory for immediate use if careful attention is given to their preparation and use. In all spraying with oil emulsions it is best to empty the hose into the spray tank or on to the ground after standing for any length of time.

Petroleum oil as an insecticide

Kerosene alone is, as already indicated, too volatile for any but limited use as an insecticide. It can, however, be used at 3 to 6% concentration in the emulsion for the control of highly susceptible insects such as aphids, thrips and newly hatched scale insects, although for this purpose other materials such as nicotine and pyrethrins are more easily handled. Kerosene is also used as a carrier for rotenone and DDT in citrus spraying; it should, however, be handled with care as injury to the tree will result if it comes in contact with the roots.

It may be mentioned that large-scale spraying operations are being carried on in Mexico for the citrus black fly, *Aleurocanthus woglumi*, using 3 gal. of kerosene, 2 lb. of DDT, and 4 oz. of dried blood albumen per 100 gal. of spray.

Anti-parasite oils

Stove distillates and slightly refined light crude oils may be used on the roots and walls of poultry houses for eradicating mites and ticks, and on ' rubbing posts ' in the hog pen for hog lice. Such oils should, however, not be used on trees unless they are entirely dormant and even then with caution.

Dormant spray oils with an unsulphonated residue of 65 to 70% and viscosities of 90 to 110 sec. Saybolt at 100°F. are commonly used on dormant trees at the rate of 3 gal. of oil per 100 gal. of spray. They are effective without other insecticides against most scale insects and the winter eggs of plant mites on apple, pear, peach, plum and prune. The same oils are used against the pear psylla, *Psylla pyricola*, and the winter egg of the fruit tree leaf roller, *Cacoecia argyrospilla*. For the winter eggs of aphids on apples, one of the dinitro compounds such as sodium dinitro-o-cresylate is commonly used in dormant oils.

Oil sprays should not be applied in the autumn but as early as possible in the spring. (Under California conditions dormant oil sprays are applied after the first heavy rain of the fall or early winter.) Oil sprays should not, however, be applied when the temperature is below 40°F. or when the spray will freeze on the tree at night. Emulsion types which are affected by freezing should be protected.

Foliage sprays are largely used in the control of plant mites of various types, at 1 to 2% concentration of oil. The heavier the oil used the smaller the amount per 100 gal. They are also used against pear psylla, mealy bugs (*Pseudococcus* spp.) and combined with lead arsenate, in codling moth control. For the latter purpose the concentration used is $\frac{1}{4}$ to $\frac{1}{2}$ gal. per 100 gal. of spray.

Citrus tree spraying with foliage type oils has for many years been a common practice, particularly where resistant forms of scale insects have developed after years of fumigating with hydrocyanic acid gas. The oil type used and the time of spraying for such applications vary greatly with local conditions. The concentrations employed usually range from $1\frac{1}{2}$ to 2 gal. of oil per 100 gal. of fluid. The lighter and less viscous oils should be used where possible. If it is necessary to use heavier oils they should be applied during the dormant stage of the tree.

Effect of oil sprays on plants

The action of refined mineral oils (85 to 94% unsulphonated residue) on foliage is physical rather than chemical. The reactions of oils on plants may be advantageous under certain conditions when they are used with understanding of their effect. For example, blooming dates may be advanced or delayed, growth stimulated or retarded and transpiration of moisture retarded for short periods by judicious and appropriate spraying.

When oil is applied to foliage it penetrates to varying distances in the tissues; it enters through the breathing pores (stomata), but the lighter fractions may penetrate also through the epidermal surface. Oils which penetrate in this way may also enter living cells and this interferes with normal functioning of the leaf; accordingly, it is necessary to choose spray oils with care and with due regard to their effect on the plant.

The penetration of petroleum fractions into the leaf is largely regulated by the viscosity of the oil and as has previously been shown this is influenced by the prevailing temperature. Light lubricating oils with viscosities of 45 to 60 sec. Saybolt enter the stomata readily and penetrate throughout the leaf in a matter of a few days, while translocation to other parts of the plant progresses steadily. More viscous oils of 65 to 85 sec. Saybolt are deposited as films on the leaf surface, where they may persist for several days. However, they too, gradually penetrate into the leaf, albeit more slowly. Heavier oils of 95 to 105 viscosity on the other hand only penetrate a short distance into the leaf and when they do they remain fixed there for long periods of time. On long persisting leaves, such as citrus, it may require months for them to be carried into storage tissues. These reactions are not uniform over an entire tree but only on leaves that have been thoroughly coated with the spray emulsion. The physiological effect of kerosene and the lighter lubricating type of oils is so slight as scarcely to be measurable in crop yields; on the other hand, the effect of the heavier oils is much more marked. Photosynthesis may be affected with reduction in the amount of sugar produced, increased acidity, and lowered weights of crop. On citrus trees heavy oils may be present in the leaves for months with resulting clogging of intercellular spaces and tracheids, which may cause leaf burn and also result in dead wood. Injury of this type is called ' chronic.' It is, however, now very rarely seen since the danger from the use of heavy viscous oils both on apples and citrus trees is widely known. The heavier oils are now reserved for treating only the most resistant insects, and they are always applied in the season safest for the tree. In any event, only oils of a high unsulphonated residue should be used (92 to 94 u.r.) for such applications. On stone fruits no oil sprays at all should be used within four or five weeks of harvest because of the solvent effect on the waxy bloom of the fruit.§

Acute injury may occur between 1 and 20 days after application as the result of using oils of a low degree of refinement; if the aromatics are not removed, they are very active on foliage; recent studies of petroleum herbicides have, for example, shown that they are very toxic at concentrations of 15 to 20% (see p. 20). Such injury, however, rarely occurs where the oils employed have been properly refined for use on plants.

Another type of acute injury, which is sometimes noted 3 to 25 days following an application, is caused by using oils which oxidise readily and form organic acids dangerous to foliage. This type of injury is seen as small discoloured areas in the blade of the leaf, which may converge and kill the leaf. This danger has been generally recognised by oil refiners and the fractions chosen for spraying oils are either of a stable type restricted to ability to oxidation or have had chemicals added which prevent it.

§de Ong, E. R.: ' Chemistry and Use of Insecticides,' Reinhold Publishing Corporation (1948).

(Photo p. 19, a Shell photograph).

The Zande Scheme in the Anglo-Egyptian Sudan

The improvement of conditions of native peoples in remote areas is one of the great problems of today. The scheme for the development of the south-west corner of the Sudan started some five years ago is particularly interesting, since it represents a constructive contribution to its solution. The following account has been condensed from an article by Mr. H. Ferguson, in the Empire Cotton Growing Review, and a broadcast talk by Mr. A. G. McCall, both of whom are members of the staff of the Ministry of Agriculture in the Sudan.

THE south-west corner of the Anglo-Egyptian Sudan is inhabited by the Azande—a near Bantu tribe of mixed origin. It was for their social and economic development that the scheme was planned. The Zande district comprises some 20,000 square miles of undulating plateau country in the Nile Congo basin. Yambio is the headquarters of the district which has a population of some 180,000 people, mostly centred in the wetter, richer area near the watershed. The rainfall averages nearly 60 in. per annum and falls during the months of April to November; in the remaining months of the year there is a marked dry season. The soils are lateritic and not particularly fertile; the vegetation is grass woodland intersected by gallery forests along the water courses; cattle are excluded by tsetse fly and the area has to depend on plant products for its subsistence. There are no workable mineral resources.

The tribes inhabiting the area are therefore essentially agriculturists. Their system of agriculture is primitive-shifting cultivation and their tools are the simplest. Normally they produce enough food to feed themselves, but distance from markets outside the area and high costs of transport have made it economically impossible to export surplus produce. This factor of remoteness gave rise to the scheme, and is indeed a fundamental difficulty in many other central African territories.

Lint coming out of the cotton gins, Nzara, 1950

The scope and objects of the scheme

The scheme was originally formulated in December 1943 by Dr. J. D. Tothill, C.M.G., then Director of Agriculture in the Sudan. In an official memorandum entitled ' A Suggested Experiment for the Social Emergence of Indigenous Races in Remote Areas,' he recommended a policy of endeavouring to make these areas very nearly self-sufficient, the basis of which would be the processing of the primary products of Zandeland on the spot thereby making manufactured goods locally available and eliminating heavy export and import costs. A proportion of the manufactured goods would also be available for sale in other parts of the Sudan and this would earn sufficient external credit to pay for the necessary organisation and expansion of public service and allow for limited imports of goods and materials incapable of local production. Economic development on these lines was held to be the means to an end and the scheme aims ' at nothing less than the complete social emergence and economical stability of the Zande peoples.' Tothill envisaged that the process of establishing a civilised and prosperous peasantry in this way would occupy about 30 years; he laid great stress on the need for universal and progressive education of the right kind if the fulfilment of this remote area policy was to be achieved.

Details of the scheme

The central key of the scheme was the establishment of a cotton industry which would provide for the growing, spinning and weaving of cotton within the district, and the export from the district of the cloth manufactured. Cotton had been grown commercially for many years in similar neighbouring areas in the Congo and Uganda ; prior to the inception of the scheme small trials had been carried out in Zandeland for a number of years. These had shown that American Upland cotton was well suited to local conditions, and a final target was set for the annual production and processing of about 10,000 bales of lint per year, which would produce 1,785 tons of cloth of which 1,500 would be sold outside the district. In addition to cotton, the local production of oil from cotton seed and also from oil palms (conditions for the cultivation of the latter being considered favourable) was proposed. It was envisaged that at any rate part of the production of oil would be used for the manufacture of soap. A further item in the scheme was the cultivation of sugar and the production of Jaggery (a form of concrete sugar which is extensively produced in India). Other possible projects

suggested were the growth of Deccan hemp or jute for the production of fibre for gunny bags and the development of timber products. All of these would be available for trade with nearby districts. Tothill confined his definite proposals to the above projects, but recommended enquiries into the use of other local resources including locally produced building materials, charcoal for fuel, and even the resuscitation in improved form of the iron smelting at one time practised by the people.

It was proposed that the scheme should be established with Sudan capital and on a partnership basis, although the people would participate in the first place only as producers of raw materials. Definite areas of Zandeland would be earmarked for individual crops and these together with food products would be grown by existing family units in their own cultivations.

To manage the commercial undertakings and to supervise agricultural production, a board would be established under charter from the Governor-General of the Sudan. It was envisaged that developments would take place in ' gradual and orderly steps; but the first step should be bold and big enough to enable the Board to function actively, establish pilot units and carry them through their inevitable teething troubles.'

The proposals were approved by the Sudan Government in 1944, and during 1945 details for their implementation were worked out and preliminary work started. The ' Equatoria Projects Board ' came into being in 1946 and was entrusted with the management of the production and trading projects. It was estimated that the Board would require a capital of £E.1,000,000, and this sum was accordingly voted by the Sudan Government.

Implications of the plan

On the production side the essential points of the scheme are:

(1) The growing of cotton and other cash crops by the people on a considerable scale and in accordance with proper precautions to ensure the prevention of soil erosion and the control of diseases and pests of the crop.

(2) The building of an industrial centre at which the cotton would be ginned, spun and woven into cloth and oil would be expressed from the cotton seed and manufactured into soap.

(3) The establishment of small oil-palm plantations equipped with the necessary plant.

(4) The establishment of sugar-cane plantations and the erection of a Jaggery sugar factory.

A further implication is that cultural and social development must keep pace with economic development, and in addition to providing funds for the industrial and commercial side of the scheme, substantial contributions will have to be made for the expansion of public health and educational services, and for the improvement of communications.

Administrative considerations

At the time of the inception of the scheme the population of the Zande district, though socially organised in chieftainships, was scattered throughout the countryside, often in very inaccessible regions. It was early realised that supervision of the scheme would be impossible without some form of grouping and reorganisation. Accordingly, Major J. W. G. Wyld, who was at that time District Commissioner in Zandeland, proposed a resettlement plan which would not only facilitate agricultural supervision, but also general administration and the operation of educational and public health services. His plan was adopted and put into effect with such vigour that at the present time 95% of the population has been resettled. Under the plan the chieftainships were subdivided into units known as gbarias, each under a headman answerable to the chief according to tribal custom. They can best be described as dispersed villages, each containing about 50 families and covering an area of 2-3 square miles; in these each family was allotted an area of 30-40 feddans for cultivation on a long-term rotational system. The gbarias are laid out along straight lines which are kept open for use as cycle tracks and each householder has a given frontage thereon. This resettlement provided a convenient means of supervising the production of the various cash crops. Agricultural supervisors were posted to the gbarias who were responsible for laying out standard plots on which the approved cash crops are grown, and for seeing that holdings are cultivated in accordance with approved instructions. The cash crops which have so far been grown under this system are cotton, dura and groundnuts; this year, for the first time, simsim (sesame) is also included.

Progress to date

(a) Cotton growing

It was fortunate that the very high prices for raw cotton which have prevailed of recent years enabled cotton growing to be started before it was possible to erect the spinning and weaving factories; owing to the high price the export of lint became economically practicable despite the long distances the crop had to be carried. This is, however, accidental and in the future the aim will be to manufacture cloth on the spot and only a small part of the crop produced in the areas nearest to the river will be exported as lint.

Cotton cultivation started in 1945, in which year 80 acres were sown by selected cultivators; production on a large scale commenced in the succeeding year, 1946. Further expansion occurred in 1947 when 5,400 acres were sown by 12,255 householders, while in 1948 9,700 acres were sown.

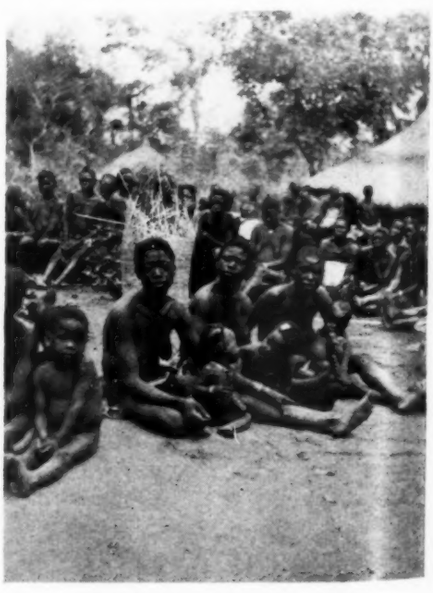
During this period the production of seed cotton has been as follows:

1946	..	15,000 small kantars
1947	..	40,000 small kantars
1948	..	34,000 small kantars

These crops were produced on small plots of about half a feddan each, scattered all over the countryside. It is estimated that their total number during the current season exceeds 20,000.

Despite the rapid expansion, yields have been well maintained and have ranged from 340 up to 514 lb. of seed cotton per acre. They compared favourably with those obtained in Uganda and are similar to those obtained in parts of the Belgian Congo. No pests or disease have so far caused serious damage to the cotton crop, though various pests found in other parts of the Sudan have been recorded.

Of the other cash crops growing on the family holding, dura has so far been produced on the largest scale, in order to provide grain for the large number of Northern Sudanese who have come down to the new industrial centre. Simsim and groundnuts are among other crops whose



Azande women and children

production on standard plots has been organised. The oil expression plant, which has now been erected, started work last year and the simsim crop is being purchased thereat and oil expressed from it. The soap factory, for the manufacture of cheap soap, is in course of erection and it is hoped that production will start this year.

(b) Sugar cane

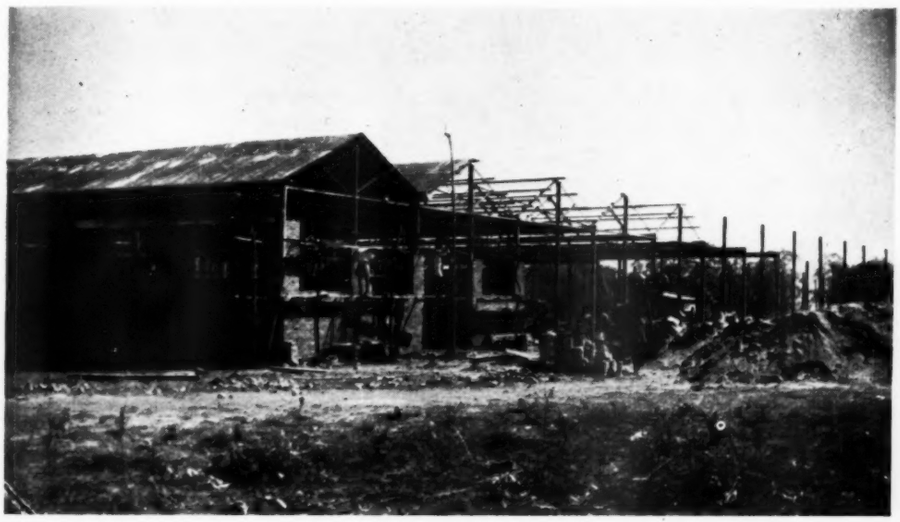
Sugar-cane planting started in 1945 on a small area of six feddans. Last season over 80 feddans of canes were under cultivation and a Jaggery plant was erected during the winter of 1948 and 1949, production commencing early during last year (1950). The variety of cane selected was POJ.27/25 (a Java seedling which had been introduced from Uganda). The mean yield of cane recorded has been nearly 20 tons per acre. The ultimate target for cane planting has been set at 1,000 acres per annum. The factory consists of a crushing mill and evaporating pans. It is anticipated that during the current season about 75 tons of Jaggery sugar will be produced. It is made up in quarter and half kilo blocks and, particularly in rural areas, meets with a ready sale.

(c) Oil palms

Progress in regard to the oil palm project has been somewhat slow owing to the decision to await arrival of selected seed from proved high-yielding palms produced in Nigeria; this subsequently arrived and the first two plantations of approximately 20 feddans each were established during 1950. It is hoped that in due course a large number of small plantations of about 30 feddans each will be established all over the territory. In addition, oil palm seedlings are being distributed to those smallholders who want them.

Progress with the building of the industrial centre

Remarkable progress has been made with the erection of the industrial centre at Nzara. The oil mill will shortly be completed, while the soap factory is also nearing completion. The foundations of the spinning and weaving factory have been dug and it is anticipated that the mill will arrive shortly and be erected. A sawmill was erected in 1948 and is now producing sawn timbers for the numerous staff houses which are required. To provide water supply a number of boreholes have been put down, while brickyards have been started which produce from 100-150 thousand bricks a month. In addition, provision has been made for the establishment of nurseries for the raising of citrus trees, bananas, pawpaws, and other fruits for distribution. A dairy has also been started in which cows are protected from trypanosomiasis by the use of antrycide.



First stages in the construction of a spinning and weaving factory; picture taken December 1949

Trading activities

A trading division has been established, the functions of which are to market the products of the scheme and to undertake wholesale and retail trade in either local products or imported articles. Its objective is to develop a sense of money values in a community unused to a money economy and liable to exploitation by private traders, to provide goods of good quality at low prices, and to train southern Sudanese to become traders or shopkeepers. The headquarters of the section is at Juba where a large shop has been established, and at this most of the trainee shopkeepers get their first lessons. Shops have also been opened or are in process of completion at eight other points, and the ultimate aim is to open bush shops all over the various districts.

In addition to shops at fixed centres the section maintains three mobile canteens which tour those areas having no shops and make stops at various places. They follow the cotton market rounds and provide cotton growers with the means of buying goods at reasonable prices with the money they have obtained for their cotton. The functions of this division are most important, and although it is still in its early stages it has already proved its value in the two southernmost provinces.

British officials in a cotton field near Yambio

Public and social services

As stated above, the Sudan Government have accepted in principle that cultural development must keep pace with economic development and substantial progress has been made towards the expansion of public services. Considerable improvements have already been made with communications; a trunk road 30 miles long has been made from Lingasi, 30 miles north-west of Nzara, via Nzara and Yambio to the river port on the Nile; a wireless station has been erected at Yambio and a telephone system installed connecting Nzara and Yambio.

Similar advances have been made in connection with public health and education; a large programme has been inaugurated aiming at establishing literacy and a cultural background to suit the people; at Yambio an agricultural and forestry training school has been established and a large agricultural experiment

station has started work. The agricultural school trains technical assistants and will provide courses for teachers.

It will be seen that the scheme is not entirely either an agricultural or an industrial scheme, but is what Dr. Tothill originally planned—a large-scale experiment in social emergence. It is, in fact, an attempt to enable the Azande, despite the inaccessibility of the region they inhabit, to develop a social existence and a standard of living comparable to those of people situated in more favourable regions. It aims at providing a better alternative to existence on a bare subsistence level and at enabling the administration to be carried on at those levels without making calls on taxpayers in other regions. The scheme has made a good start, the foundations have been well laid, and its future progress should be a matter of great interest.

1 feddan = 1.04 acre.
1 small kantar = 99 lb.
Dura = the great millett (*sorghum vulgare*).
Sesame (simsim) = *Sesamum orientale*.

Grasses and Grazing Problems of East Africa

(*See pp.* 8 - 10)

BIBLIOGRAPHY

Author's unpublished reports of research at the Nyakato Agricultural Training Centre, Bukoba, 1933-35.

Observation on Some Pasture Plants in Kenya. D. C. Edwards, B.Sc. (Agric.). Bulletin No. 1 of 1933.

Annual Report, Department of Agriculture, Uganda. Pt. II, 1945.

Annual Report, Department of Agriculture, Kenya. 1945, 1946, 1947.

New Fodder Crop: Perennial Kavirondo Sorghum. D. C. Edwards, Senior Agricultural Officer, Pasture Research, Kenya. *East African Agri. Jour.*, **vi**, 183-186, April 1941.

Kavirondo Perennial Sorghum. An improved type, R.2S42. D. C. Edwards. *East African Agri. Jour.*, **xiii**, No. 4, April 1948.

The Nzoia Type of Rhodes Grass for Temporary Leys. *East African Agri. Jour.*, **ix**, 62-68, October 1943.

Commonwealth Bureau of Soil Science. Tech. Comm., No. 45. The Practice of Soil Conservation in the British Colonial Empire. Sir Harold A. Tempany. 1949.

Essays of Applied Pedology, III. Bukoba. High and Low Fertility on a Laterised Soil. G. Milne. *East African Agri. Jour.*, **iv**, 13, 1938.

Grasses as Weeds of Pasture Land in Northern Uganda. R. N. T. W.-Fiennes. *East African Agri. Jour.*, January 1940.

Grasses as Indicator Plants in Uganda, II. A. S. Thomas. *East African Agri. Jour.*, October 1940.

Pastures and Fodder Grasses of Kenya. D. C. Edwards. *East African Agri. Jour.*, January 1940.

The Possibility of Establishing Grass Under Maize. D. C. Edwards. *East African Agri. Jour.*, April 1941.

An Investigation into the Content of Phosphorus Calcium and Protein of Grasses. Dr. M. Henrici, D.A., Union of South Africa. Science Bulletin No. 115, 1932.

The Composition and Nutritive Values of Tanganyika Feeding Stuffs. M. H. French. *East African Agri. Jour.*, January 1943.

The Fourth International Congress of Soil Science

Some of the delegates to the Congress examining a soil profile near Abee-Scry

THE first three Congresses of the International Society of Soil Science were held in U.S.A. (1927), U.S.S.R. (1930), and Great Britain (1935), and a fourth was to have taken place in Germany in 1940. As contacts between soil scientists were broken during the war it was decided at a meeting in Paris in 1947 to hold a Congress in Holland in 1950 and to reconstitute the International Society. Both objects were successfully accomplished. The Fourth Congress, held in Amsterdam from July 24 to August 1, 1950, was attended by about 600 delegates from some 40 countries. It was highly successful and the President, Professor Edelman, the members of his organising committee, and the various sub-committees are to be congratulated on carrying through the comprehensive programme with complete success.

Scope of the Congress

The Congress was officially opened by His Excellency S. L. Mansholt, Minister of Agriculture, and an official reception by the Netherlands Government and the Municipal Authorities of Amsterdam took place in the Rijksmuseum. The plenary sessions were held in the Indisch Instituut; other meetings were divided amongst nine sections, namely, Physics, Clay Minerals, Chemistry, Biology, Fertility, Tropical and Sub-tropical Soils, Conservation and Management, Land Classification and Evaluation, and Saline Soils. The bulk of the papers have already been published in volumes 1 and 2 of the *Transactions*, and a third volume is to follow.

Some topics discussed

(a) Soil structure

In an address to a plenary session Professor Bradfield (U.S.A.) stressed the importance of improving or maintaining soil structure in any scheme of increasing production by the greater use of fertilisers, since adequate water movement and aeration determine to a large extent the efficacy of nutrient absorption and are prerequisites of healthy plant growth. Different aspects of the same subject were dealt with in many papers, for soil physicists have been giving increasing attention to the factors involved in the production of a favourable structure and to methods for assessing the stability of soil aggregates. The allied subjects of the genesis, crystal structure, exchange capacity, and differential thermal analysis of clay minerals were also discussed in sectional meetings.

(*b*) Nitrogen in soils

The question of nitrogen supplies and biological fixation was dealt with on broad lines by Professor H. L. Jensen (Denmark), who pointed out that, although the greatest biological contribution doubtless comes from the symbiotic bacteria, there is room for a great improvement through the introduction of more leguminous crops into agricultural practice and the use of better varieties. Crop residues are quite inadequate for a significant fixation by azoto-

bacter, while the effect of blue-green algae is a surface one only. The part played by soil micro-organisms at certain pH levels in rendering manganese unavailable to plants was another subject of discussion in the Biology Section; this may provide the answer to a number of anomalies reported by various investigators on manganese deficiency. There were also several papers on the transmutation of organic and inorganic compounds by micro-organisms, and Professor Bear (U.S.A.), at a joint meeting, spoke in general terms on the issue of soil organic matter and fertilisers.

(*c*) Soil fertility

Problems of soil fertility were approached from many directions. At a plenary session Professor Wallace (U.K.) discussed the visual diagnosis of mineral deficiencies in plants, the interrelationships of the numerous factors in nutrition and the value of susceptible plants as indicators. The utilisation of phosphates by crops, which has been one of the most difficult problems in plant nutrition, was dealt with in more than one paper, and attention was directed to the probable value of radio-active tracers (in this case P.32) in following the uptake of a nutrient. The Soil Fertility Section also discussed C:N ratios, periodic fluctuations in fertility, plant analysis, soil acidity, and trace elements.

(d) Tropical soils

The subject of tropical soils was introduced by Professor Kellogg (U.S.A.) and the main discussion revolved round the questions of the field behaviour of ' clay ' and the nomenclature to be adopted in describing texture. Lateritic and tropical black soils and shifting cultivation in the tropics were other matters that were dealt with. The saline and alkaline soils of the Western States region were described by Professor Richards (U.S.A.) and the problems of the formation and reclamation of saline soils and of erosion control all received attention in the appropriate sections.

(e) Soils in the Netherlands

It was natural that a good deal of time should be given to the special conditions of the Netherlands. Professor Edelman had written a book, *The Soils of the Netherlands*, specially for the Congress, and the Netherlands Society of Soil Science presented a series of papers on the applications of soil science to their particular problems. Soil formation and morphology can be discussed adequately only in the field, and an international meeting provides an admirable opportunity for the pedologists of different countries to exchange ideas and compare their views on the classification of soils. Soil mapping has been vigorously pursued in the Netherlands and an excursion lasting ten days enabled many of the visitors to see a great deal of the Dutch work and many things entirely new to them.

Conclusion

At the final meeting in Amsterdam it was agreed to accept an invitation to hold the next Congress in 1954 in the Belgian Congo. This decision gave great satisfaction to soil workers who have not had an opportunity of studying tropical soils in the field as well as to those who are familiar with tropical conditions but would like to meet their colleagues on common ground. Approval was also given to a recommendation that, in view of the urgent world need for increasing soil productivity, a meeting of the Soil Fertility Section of the International Society be held in Eire in 1952 or 1953.

A. M. SMITH.

Colonial Development News

The Colonial Development Corporation have announced that they are about to start work on two major development projects in Bechuanaland. They are a cattle ranch on the Chobe Crown lands in the north and an abattoir and freezing plant at Lobatsi, together with a holding ranch, on the Molepole Crown lands in the south.

The first scheme is planned to take 18 to 21 years to complete, when it will cover some 16,000 square miles: 500,000 acres in the rain belt will be cultivated to provide additional feeding stuffs and eliminate the present grain shortage in the Protectorate. When the project is completed, it is planned to carry a very large number of cattle with an annual draw-off of 50,000. The capital required for the full project is approximately £2¼ million, but, to cover the first five years, £1,229,000 will be invested, by which time it is expected a good idea will have been found of the future of the undertaking.

The Lobatsi abattoir, together with the freezing plant, will provide up-to-date marketing facilities for Northern Bechuanaland cattle, the major industry of the Protectorate, whilst the holding ranch will ensure a steady throughput of cattle in good condition as opposed to the older methods of marketing poor cattle on the hoof at indefinite periods. The abattoir is designed to handle at least 70,000 head of cattle per annum when in full activity.

Both the above projects are designed to meet the urgent needs of the African people for meat and to establish a production and marketing organisation which will be able not only to meet the demands for good quality beef in Central and Southern Africa, but to ensure a good price to the African farmer for his cattle.

Bahamas estate

The Corporation have also purchased an 8,000-acre estate in the Southern part of the island of Eleuthera in the Bahamas. This is the first step in an attempt by the C.D.C. to make the Bahamas more or less independent of dollar imports of foodstuffs.

On the Eleuthera estate pilot areas of citrus and pineapples have already been grown and it is hoped that the undeveloped island of Andros will turn out to be one of the principal agricultural schemes of the Colonial territories of the Caribbeans. Investigations have revealed a large area of swamp land bordering a fresh-water lake in the interior of the island. Surveys by hydraulic engineers have shown that this swamp land can be drained and cultivated and work is now being started on an initial pilot area of 2,000 acres. Soil analysis has shown that these lands are likely to be as productive as similar areas in Florida and will provide in due time crops of tomatoes, fresh vegetables and potatoes for the local and U.S.A. markets, fodder crops for cattle on the other islands, and enough maize to meet the needs of the Bahamas.

Capital so far authorised for the Bahamas scheme, including the purchase of the Eleuthera land and buildings, is £1,034,020.

Nigerian fibres

In conjunction with the Nigerian Cocoa and Cotton Marketing Boards the C.D.C. are forming a company to be known as the Nigerian Fibres Industries, Ltd., which will operate a combined produce bag factory and cotton spinning mill on a site near Omitsha in Nigeria. The sack factory should be capable of producing about 6,000,000 sacks per year when in full production and it is expected that there will be an increase in the local acreage of fibre crops so that it will gradually become unnecessary to use imported material. The adjoining cotton spinning plant should be capable of producing about 2,000,000 lb. of cotton yarn per year.

The total capital investment in this project will be around £1,800,000, of which just over half will be subscribed by the Colonial Development Corporation.

Mechanisation Topics

Two papers on farm mechanisation were read in London recently—one at the Farmers' Club and the other at a meeting of the Institute of British Agricultural Engineers. The first was a survey of the use of power on farms, the second dealt with problems of mechanising the larger farm. Here are summaries of these papers.

Power in the U.K.

'IN addition to the cost, breakdowns can be disastrous to farm organisation, and now that we are reaching more stability in design it will give manufacturers a breathing space to attend to these matters. If attention is given to details such as ease of maintenance, and weak components are eliminated, there is no reason why the cost of maintenance of machinery should not be materially reduced.' These were the closing remarks of a paper read before the Farmers' Club in London recently by Mr. W. H. Cashmore, B.A., N.D.A., Director of the National Institute of Agricultural Engineering. He was surveying the present position of the use of power on farms in the U.K., and below are some of his observations:

Haymaking. Self-propelled balers are superseding stationary machines with a consequent economy in man-power, but care must be taken that damage does not occur as a result of baling damp grass or stacking in such a way that excess moisture cannot escape.

Silage. Forage harvesters, such as the one-man outfits shown at the recent R.A.S.E. trials, enable man-hours per ton loaded, carted and clamped to be greatly reduced; one machine collects from the swathe and delivers to the clamp at a rate of 20 man-hours per 100 tons, compared with 60-70 man-hours per 100 tons for the conventional green crop loaders.

Grass drying. This is now recognised as being equivalent to a factory process, requiring skilled supervision for satisfactory results. Automatic feeding devices are useful introductions, improving general working efficiency. Small capacity driers, simply operated, are meeting a fair demand.

Grain harvesting. Combine harvesting is rapidly expanding and the 1950 season saw over 12,500 machines working in the U.K. There is a danger of increase in weed population through the use of combines and decrease in popularity of stubble cultivation.

Grain drying. With the improvement in combining technique grain is being harvested with less surplus moisture requiring removal. Drying grain in sacks is a satisfactory and cheap method as an alternative to grain-drying plant or silo-drying installations.

Sugar beet. Cross blocking would eliminate much labour during the peak spring period; this can be done if processed seed is made available and an improved drill developed.

Potato harvesting. From figures of harvesting costs the best machine for the job appears to be the two-row type such as the two-row elevator digger which facilitates the job of hand picking.

Farmyard manure. Modern handling development is tending towards the 'batch' system rather than the continuous process, *i.e.* the use of a hydraulic front-end loader and mechanical spreader operated by one man with one tractor. In this way if there is a breakdown only one man and his unit are delayed, initial capital outlay is lower and mechanisation is extended to smaller farms. It may be used in groups of units on larger farms, thus increasing the demand for any one model.

Dealing with the problems of increasing yields and fertility, Mr. Cashmore mentioned some of the experimental work that has been undertaken with this object in view. Fertiliser placement trials have shown that a number of crops respond markedly to placed fertiliser, and at a lower distribution rate per acre than usual. There was a need for a one-way plough; this would eliminate the ridge and farrow, which appear along the 'lands' when the more orthodox method is employed, and thus keep the surface level which, in these days of expensive and sometimes comparatively delicate machinery, is very important. Expensive harvesting machinery cannot give the best results when bumping across ridge and furrow.

With the high proportion of small farms in the U.K., it would appear that the more versatile a machine is the better. Standardisation of row widths for various crops would help this to come about.

In Britain capitalisation of £15 an acre is becoming fairly common, and it is important that maintenance charges should not become too high—already they are sometimes as high as 15% per annum of the initial cost—and manufacturers should aim at simplicity of design coupled with reliability.

Mechanisation contrasts

A paper entitled 'Mechanisation Problems on the Larger Farms' was read at a recent meeting of the Institute of British Agricultural Engineers by Mr. D. G. Brown, who farms extensively in Northumberland. He described how he had dealt with the problems of mechanising the farming system, which in his area is based on three-year leys. The main farm products are beef and mutton from the leys and malting barley from the arable land. An eighty-year rotation is practised, consisting of two straw crops, one green crop (potatoes or sugar beet), two straw crops and the three-year ley. The soil is a fertile medium loam in boulder clay and there is an evenly distributed annual rainfall of about 27 in.

The speaker divided the problem of mechanising into three requirements which were, briefly, to avoid the employment of casual labour, to mechanise the handling of each crop and product from seeding to harvest and to have each worker equipped with a tractor that he can operate throughout the year on as many jobs as possible (excepting machines for special jobs such as combines, balers, etc.).

The shortage of casual labour was making farmers reluctant to grow crops which could not be handled by regular staff and the potato crop was being reduced in favour of sugar beet which can be harvested mechanically. Farmers who have no combines are reluctant to grow even the minimum acreage while those with these machines and ancillary equipment can, for the most part, cope with their cereals without anxiety.

Buying implements was of paramount importance; Mr. Brown emphasised the importance of planning the work from seeding right up to harvest and after if necessary. For instance, it was no use ordering a combine if there were no facilities for storing and drying the grain. It was important to watch trends in design when fitting new implements into the mechanisation process and not to buy an expensive machine which appeared likely to be superseded by something better in the near future. The standardisation of the three-point linkage was a great boon and it was essential for all tractors to be equipped with hydraulic lifts in order to be fully employed the whole year round.

Mr. Brown considered that his main need in farm mechanisation was a reliable potato harvester; so far, none of the machines tried had been successful because of the stony condition of his soil.

The spares position was not always easy and it was suggested that manufacturers should supply more spares to their agents and perhaps even a few spare parts with a new machine instead of the usual tool kit which is in many cases split up, scattered about the farm and used for jobs of all kinds.

Following the paper a vote of thanks was moved by Mr. E. Cave from Norfolk, who farms a considerable acreage in the King's Lynn area. He said that in his part of the country mechanisation was carried out not because of labour shortage, but to increase farm production. Referring to the question of combine harvesters, he considered that if the straw was to be used for specific jobs like covering potato clamps or laying in yards harvesting was just as cheap with a binder and stationary thresher. Normally he did not need a grain drier, storing grain in glass chitting houses and running it through a dresser a few times. On his farm he grew peas for canning and had found that the mechanical cutter took the headache of the harvest away; loose loading would help further to mechanise the harvest. Potatoes were still planted and harvested by hand because a mechanical planter did not save much cost and a mechanical harvester was apt to bruise the crop.

It appears from the latter's remarks that farm mechanisation requirements in his area are quite different from those in Northumberland. This reiterates the argument that there can be no standard 'rules' for mechanising farming and in the last resort a farmer must dovetail his mechanising into his own farming system and, as no two systems are identical, successful and economical mechanising can only be achieved through trial and error and intelligent application.

Rising Prices Cause OFC Concern

The Overseas Food Corporation in Australia now has machinery capable of cultivating up to 80,000 acres and the number of cattle exceeds 15,000. Concern was expressed in the Annual Report, published recently, at the possibility of appreciation of the Australian pound. Crops have to be sold on a forward basis and the rising cost of materials and labour have necessitated economy and high efficiency in all operations.

Overseas Food Corporation

Report and Accounts for 1949-50

Part of the sorghum crop at Peak Downs, Queensland

COMING as it does after the publication of the report of the working party on the Kongwa part of the East African groundnut scheme, comment upon which appeared in the editorial columns of WORLD CROPS last month, and preceding the promised appraisement of the whole scheme to be presented shortly to Parliament, the present report* of the Overseas Food Corporation, referring to the period April 1949 to March 1950, is to some extent out of date; any comments on the East African aspect must therefore be confined to matters in the report itself. It does, however, provide some interesting details about the position in East Africa and some welcome news concerning the second project, for which the Corporation is responsible, in Queensland.

The East African schemes

The rainfall at Kongwa and Urambo during 1949-50 was far more favourable than in either of the two preceding seasons; in the Southern Province also it was decidedly better than in 1948-49. Notwithstanding this, the results were again unsatisfactory; the target figure for planting was in no case realised, and from the report of the Kongwa working party it transpires that yields were very low. On pages 19 and 20 of the report the factors responsible for this are discussed; one of the major difficulties was rapid weed growth on the onset of rains (paras. (g), (h) and (k)) which it was impossible to control effectively without upsetting the planting programme. It is stated in para. (h) that the same difficulty was not experienced in the previous season, but as this was one of drought the absence of moisture which inhibited the growth of weeds also inhibited the growth of crops. Excessive weed growth at the onset of rains is always a difficulty, but in the tropics, where high temperatures favour extremely rapid growth when moisture conditions are favourable, it can become a major problem. It is hardly to be wondered that when for the first time planting conditions were relatively favourable at Kongwa, it should have caused difficulties, especially when the shortness of the planting season necessitates that every effort must be concentrated upon getting the maximum area planted in the minimum of time. It is understood that this may have been foreseen in some quarters before the scheme was launched, but it would seem that it was not fully appreciated in the earlier stages.

It is also interesting to read in para. 46 that 'progress of work in the three regions has emphasised the importance of detailed forward reconnaissance of land before any forward clearing takes place.' One can wholeheartedly endorse this. It is unfortunate for the scheme and incidentally for the British taxpayer that its truth was not recognised earlier.

It is reported (see paras. 52 to 59) that such reconnaissances as have been possible in the Southern Highlands reveal great variability in the characters of the soils; in consequence the programme has been substantially modified, and the need is stressed for immediate experimentation on all types of soil so that future clearing operations can be intelligently planned. It is inferred, although it is not expressly stated, that considerable expenditure may have been incurred in the Southern Highlands on land clearing, erection of saw mills, construction of pipelines and similar matters which might have been avoided had this essential provision been undertaken at the outset.

Chapter 7 deals with soil conservation and it seems that difficulties here may also have been underestimated. Serious sheet erosion with incipient gullying is reported from Urambo (para. 79), while in the Southern Province cleared drainage

* His Majesty's Stationery Office, London, 3s. 6d.

lines are stated to have eroded badly during the 1949 rains (para. 87). It would seem that one of the difficulties may be the establishment of suitable grass covers for water meadows, drainage outlets and protective grass strips in a country of marginal rainfall. It all goes to show how difficult it is to prescribe in detail conservation measures suited to particular conditions without preliminary trial.

Appendix 3 deals with land clearing and agriculture. There is little doubt that the Corporation have achieved notable advances in the mechanical clearing of the type of bush and scrub forest country peculiar to these regions, while the section dealing with agriculture summarises the experience gained in relation to mechanical cultivation. In both cases it is clear that the special conditions present problems not previously encountered, the solution of which demanded new techniques and often new or modified implements. The information thus made available is valuable in the extreme, but could it not have been got by experiments on a few thousand acres, such as recently were recommended by the Kongwa working party?

In this connection an interesting development is the establishment of an operational research unit which has been largely concerned with the design and modification of machines and implements suited to the peculiar conditions (paras. 249-255). It is an obviously essential provision and the need for it might have been foreseen from the start.

Chapter 12 and Appendix 5 of the report give an account of the scientific work and are full of interest. The range of work carried out, under somewhat improved but still far from adequate conditions, is impressive; it included meteorology, soil studies—both on the pedological and fertility aspects—experimental crop studies and research on crop protection. In the latter aspect Rosette disease of groundnuts came in for much attention. It proved particularly serious in the Urambo region; to the reviewer it seems not unlikely that it may ultimately be a source of difficulty in the Southern Highlands as well, although it has not so far apparently been serious. Earlier hopes that it could be controlled by close planting have not been completely borne out. It seems, however, that the new phosphorus-containing systemic insecticides may offer a hopeful line of attack.

The advances made on the medical, health, educational and other social services (Chapters 14 and 15) are also impressive and obviously a vast amount of valuable work has been done under difficult conditions. It must, however, be borne in mind that the work is ancillary to development, and that had the development not been undertaken the *raison d'etre* for it would not have occurred. One wonders whether the money would not have produced more substantial results in the aggregate had it been expended on improvement of health and social conditions in the territory at large.

Hereford bullocks at Cullin la Ringo in the central highlands of Queensland

It is regrettable that the defects in the accounting arrangements revealed in the previous report have persisted to a considerable extent despite strenuous efforts to improve matters (Part IV, pages 46-49).

Taking the report in its East African aspects as a whole one cannot avoid the conclusion that, probably quite naturally, at present the whole undertaking may be suffering from lack of defined aims. The original conception has shown itself incapable of fulfilment and to convert it into something of real and permanent value a complete and realistic overhaul is essential. It is hoped that the promised White Paper will provide this; meanwhile, further comment would be inappropriate pending its appearance.

The Queensland project

This project took its rise in 1948 and a brief account of it based on information supplied by the Corporation appeared in this Journal in the issue of September 1949. The undertaking is operated as a subsidiary of the Overseas Food Corporation under the title of Queensland-British Food Corporation. It is financed by advances from the OFC and the Queensland Government. The Corporation have acquired eight properties in the Central Highlands of Queensland with a total area of 487,121 acres, on which to grow crops for fattening livestock, including cattle and pigs, for ultimate export to the British market as well as for the export of grain overseas. The main crop chosen for the purpose is sorghum and it is produced entirely by mechanised methods. Other crops under trial include sunflowers.

The lands are flat to rolling treeless plains covered in grass, which were once good cattle country, but for many years have been overstocked with sheep and cattle and their nutritive grasses have been eaten out. The soil is, however, understood to be a black loam of high natural fertility. The rainfall is said to average 20 in. per year, but to be very variable.

During the first year, 1948-49, 29,286 acres were planted under sorghum and it was anticipated in the early stages that a crop exceeding 1,000,000 bushels of grain would be reaped. Actually the crop harvested fell far below this, amounting to 316,000 bushels, or 616 lb./acre, which was about 80% of the quantity originally estimated for production in the first year of operation.

The shortfall is stated to be due to losses occasioned by lodging and also to frost damage in May. For the season 1949-50 66,432 acres were sown; at the time of writing the report no details were available of the size of the crop reaped, but from enquiries made since it transpires that it amounted to 1,240,000 bushels, or 940 lb. per acre.

Cattle and pigs

The Corporation have started a herd of cattle for production of meat which had been built up to 15,000 head by March 31, 1950. It is also contemplated to establish a number of piggeries, of which one unit numbering 1,152 pigs had been brought into being at the end of March. Trial consignments of meat both on the Australian and English markets have been well reported on, while 89,681 bags of sorghum

weighing 5,957 tons were shipped to England and sold for £106,125.

The liabilities of the Corporation amounted on March 31 to £1,781,493 capital assets, advances and stores. Of this, £1,239,000 was advanced by the British Food Corporation and £413,000 by the Queensland Government, while the loss on the operating account for the first year amounted to £305,876.

Promising outlook

Allowing for the inevitable initial difficulties, the progress appears to be promising. It must not be overlooked, however, that during the first two seasons the rainfall was higher than the average, and it seems still uncertain what the results will be when more normal seasons are experienced, or when the inevitable cycle of dry years comes round. The terrain—open grassland—is, of course, far more favourable to mechanised farming than the areas in East Africa, and, so far as one can judge in the absence of detailed statements, no particular difficulties in this regard have been experienced.

Beyond the very general statement that although the land had previously been heavily overgrazed, it is of high natural fertility, little has been made public concerning the general character of the conditions, and there is no evidence that reconnaissances, on the lines which experience has shown to be so very necessary in East Africa, have been carried out. It may be, of course, that the information is available as the result of work by the Australian authorities; if so, it seems desirable in principle that it should be made public. After all some £1,652,000 of British and Australian taxpayers' money is involved, a very considerable sum although it is small compared with what has been expended in East Africa.

It is not altogether reassuring to learn that it was only just prior to the end of the period reported on, *i.e.* approximately two years after the inception of the Committee, that steps were taken to organise a scientific committee to plan scientific work and to advise the Corporation and its staff.

Judgment must wait

All will wish the enterprise well, but judgment on the outlook must to an extent be suspended until the results of the first two seasons' working have been supplemented by experience under more normal weather conditions.

(Photos: Overseas Food Corporation.)

NEW BOOKS

Agricultural Science in the Sudan

By R. L. Knight and B. M. Boyns. Pp. 251. T. Buncle, Arbroath. 1950. 20s.

Research has played an indispensable part in the spectacular agricultural developments in the Sudan which, in the short space of 50 years have helped to raise the country from primitive savagery to the prosperous conditions which prevail today.

The story of Sudan agriculture has already been admirably told in *Agriculture in the Sudan*, edited by Dr. J. D. Tothill and published in 1948; to this the present volume forms a valuable adjunct. It lists all the papers so far published dealing with agricultural research in the Sudan since the early part of the present century —some 969 papers in all—and provides clear and detailed abstracts of all those of outstanding importance, many of which are now difficult of access.

The abstracts include not only work on purely scientific aspects carried out by agricultural research workers, but also a number of papers dealing with economic questions. Naturally the main emphasis is on cotton, since it is on that crop that the prosperity of the territory is largely based, but the book also contains accounts of research on many other crops and also on such matters as soil problems, weed control, diseases and pests, and so forth.

For research workers in the Sudan the book should certainly fulfil the expectations of its compilers that it will provide a handy and convenient source of reference, while it should also be useful to research workers and agricultural staff in other countries with similar climatic and ecological conditions.

The authors are to be congratulated on the successful completion of a task which must have involved a vast amount of labour, and the result should prove of value for many years to come.

H.T.

Grain Storage

Grain Storage in East and Central Africa. Report of a survey by T. A. Oxley. Pp. 43. Illustrated. H.M.S.O., London, 1950. 3s.

The author of this report, an expert in grain storage, was seconded from the Department of Scientific and Industrial Research, at the request of the Colonial Office for a period of three months from October 1948 to January 1949, in order to undertake a sample survey of problems of grain storage under tropical conditions. The survey took him through Kenya, Uganda, Tanganyika, Northern and Southern Rhodesia, Nyasaland and the Anglo-Egyptian Sudan.

In this published report, it is made all too clear that the dearth of grain storage facilities in East Africa, particularly as reserves against famine, is causing wastage of food and money on a large scale every year.

During his tour, Mr. Oxley found great difficulty in obtaining reliable information concerning costs of grain stores. There is a widespread belief that the smaller the store the cheaper the cost per ton of grain handled; this is because the more rudimentary the structure the more likely is its costing to be incompletely carried out. From the various estimates that were obtained, tentative figures for capital costs of various types of store are suggested, which is all that could be done under the circumstances.

The report includes a list of the most important insect infestors seen during the survey, with notes on their occurrence. It appears that the rice weevil (*Calandra oryzae*) is the commonest pest of stored grain in East Africa, excepting in the Sudan. Altogether 11 species of insect pests are listed.

With regard to materials used to combat pest infestation, Mr. Oxley has mentioned BHC, DDT and pyrethrum, but the methods of application used are not always effective, particularly when, as is often the case, there is but scant knowledge of their efficiency on various insects. Fumigation with carbon disulphide is very popular, although the application of techniques vary considerably in their effect. The use of the more up-to-date and also more toxic fumigants is not recommended unless the work can receive European supervision because of the dangers involved.

Methods of storage are fully discussed and there is included an account of an experiment carried out in Nairobi by the author and others which confirmed the view that insect infestation is mainly confined to outer layers of bag stacks in storage. Bulk storage, storage in unprotected heaps and in tanks or bins is also dealt with. In a series of recommendations, which are divided into two categories, for the Colonial Office and for those concerned with grain storage in the tropical colonies, Mr. Oxley advocates, among other things, the establishment of a grain storage advisory service, the study of grain store de-

sign by the Colonial Office and the storage of grain as soon after harvest as possible, *i.e.* get them away from the producer.

The report is illustrated with about 40 photographs of good and bad grain storage encountered by the author during his travels and it may be said that in the limited time at his disposal, he has faithfully recorded the grain storage position in Central and East Africa at the present time.

R.G.P.

Fertiliser Trade

A Survey of the Trade in Fertilisers. Commonwealth Economic Committee Publication. Pp. 125. H.M.S.O., London. 1950. 3s. 6d.

Appointed by the Commonwealth Governments to report on the fertiliser trade of the world's principal producing countries in general and Commonwealth countries in particular, the Commonwealth Economic Committee has produced a general picture of production, consumption and trade in nitrogenous, phosphatic and potassic fertilisers, the three main commercial groups.

This survey is laid down on similar lines to the pre-war publications of the C.E.C. (*e.g.* Maize, 1934; Tobacco, 1937; Canned Food, 1939) and is extremely thorough for its size. A general review at the beginning describes the importance of the three major plant foods in agriculture and the development of commercial fertiliser production. There is also a summary of world production, trade and consumption, and the net trade position in the Commonwealth. Then there are more detailed accounts of the fertiliser trade in Commonwealth countries and other areas.

World production of all three plant foods has risen to well above pre-war figures: although nitrogen and potash suffered wartime setbacks, output of the former in 1948-49 was 3.3. (pre-war 2.5) million tons and of potash 3.2 (pre-war 2.8) million tons, while manufactured phosphate output advanced from 3.5 million tons in 1938 to 3.9 million tons in 1946-47 and then to 5 million tons by 1948-49. Most of the world's nitrogen is synthetic, a substantial proportion by-product and only a relatively small part in the form of Chile nitrate.

The Report points out that while fertiliser consumption in many countries was reduced during the war, the heavy increases in Canada and U.S.A. raised the total for the world above the pre-war level: thereafter demand increased in other areas also, largely to make good the accumulated deficits of the war years. By 1948-49 overall supplies had caught up with requirements and international allocation had been abandoned. The Commonwealth accounted for about 10% each of the world consumption of nitrogen and potash and about 20% of the phosphate.

Total exports of nitrogen in 1949, at nearly 1 million tons, were the highest ever recorded. The Commonwealth is a net exporter of nitrogen, on a considerably larger scale than before the war, shipping in 1949 (mainly from the United Kingdom and Canada) nearly 20% of the world total and well over twice as much as was imported into all Commonwealth countries. World trade in phosphate recovered rapidly after the war and by 1949 was about one-third higher than before the war. In this case the Commonwealth is a net importer, taking nearly twice as much as before the war and about one-third of world exports. Potash, mainly an export of France, Germany and Spain, suffered a heavy wartime reduction but this was more than made good by 1949: Commonwealth countries do not export potash but imported between them nearly one-quarter of the world's total in 1949.

Seeds

Report of the Committee on Qualitative Control of Seeds. Pp. 31. H.M.S.O., London. 1950. 1s.

'For too long there has been a tendency to regard seeds as in the same category as such non-living raw materials as lime or superphosphate'; so says the Committee on Qualitative Control of Seeds in the introduction to its recently published report which includes a number of important recommendations which, if carried out, should raise considerably the purity standards of the main classes of agricultural and vegetable seeds in the U.K.

The present Seeds Act became law 30 years ago, since which time it has not been reviewed; one of the Committee's recommendations is that a technical committee for consultation on seed matters should consider the working of the Act and Regulations at regular intervals. During the last 30 years there have been many changes and innovations in the seed trade, including the introduction of hybrids and crosses of different types of plants. The Committee has therefore reviewed the existing list of seeds which came under the Act, and recommended its enlargement by adding 12 more varieties to the present list of herbage seeds, including mixtures of Italian and perennial ryegrass, short rotation ryegrass, wild white clover, kidney vetch and yarrow; also adding maize to the list of cereals and nearly doubling the field, root and vegetable seeds' list.

Other recommendations included minimum limits of purity and germination, below which seeds should not be sold for sowing purposes, and an upward revision of the present limits above which purity and germination need not be declared. The list of injurious weeds has been extended and it has been recommended that particulars of the numbers of weeds of seed samples should be stated, with prohibition of sale of seeds containing more than 1% by weight of prescribed injurious weeds for cereals and more than 2% for seeds other than cereals.

With regard to seed-borne diseases an *ad-hoc* committee recommended co-ordination and extension of inspections for diseases in the existing seed crop certification scheme. The tendency to buy varieties recommended by the National Institute of Agricultural Botany and, in Scotland, agricultural colleges and official bodies, should provide a valuable basis for still further improvement and the use of varieties of strains of proven value is to be encouraged.

At the end of the report it is proposed that a technical committee be set up to consider the question of seeds, with various sub-committees covering certain aspects and there should be representatives on these from the Ministry and appropriate research institutes.

For all those whose business it is to buy, sell, or grow seeds this report will be of value, particularly as it seems likely that many of the recommendations will be incorporated with the present legislation relating to seeds regulations.

R.G.P.

To Authors and Readers

The Editor and Publishers of WORLD CROPS will be glad to consider manuscripts of books submitted for publication. We already publish a number of books on technical subjects, all of which find a world sale and most call for regular reprints and new editions.

Books of a non-fictional type in any language by any publisher can be supplied by the Book Department of WORLD CROPS.

A New Research Station for the Empire Cotton Growing Corporation

THE new Cotton Research Station, in Uganda, of the Empire Cotton Growing Corporation, was formally opened by the Governor, Sir John Hathorn Hall, G.C.M.G., D.S.O., M.C., on November 9.

Representatives from most of the major cotton growing territories in Africa were present, together with a large gathering of local residents.

The station is situated at Namulonge, some 16 miles north of Kampala, and the main buildings—The Parnell Laboratories—have been named after Mr. F. R. Parnell, the first Director of the Station who, after spending over 20 years in charge of the Corporation's main Experiment Station at Barberton in South Africa, moved to Uganda in 1946 in order to undertake the establishment of the Station and assist in the planning and building of the laboratories. Mr. Parnell, who was present at the opening ceremony, retired towards the end of 1949, and was succeeded by Dr. J. B. Hutchinson, C.M.G., the former head of the Genetics Department at the Corporation's Research Station in Trinidad.

The capital cost of the Station has been borne by the Corporation and the Colonial Development and Welfare Fund, supplemented by generous grants from the Cotton Industry War Memorial Trust and the Raw Cotton Commission. The recurrent expenses will be shared between the Corporation, the Colonial Development Fund, the Sudan Government and the Governments of the cotton growing Colonies in Africa.

The buildings

The main building is a single-storey H-shaped block, built of brick with a tiled roof. The two wings form the laboratories of the various departments, while the centre portion contains the library and administrative offices.

The staff houses, 14 in number, are of a standard design with two living rooms, a kitchen, verandah and garage on the ground floor and three bedrooms and a bathroom above.

These buildings, together with the farm office, were erected by an outside contractor, but the others, such as a rest-house to accommodate visitors, outside laboratories, workshops, produce stores, labour lines and houses for non-European assistants, have all been built by the Station Staff.

The inauguration of the new Research Station of the Empire Cotton Growing Corporation in Uganda is an event of considerable importance and interest wherever cotton is growing. The following is an account, supplied by the Corporation, of the station and the programme of work which will be carried out there.

Programme of work

The programme of work for the Station, drawn up by the Director and his staff, has been reviewed by the Corporation's Scientific Advisory Committee in London, and by the Advisory Board of the Station.

The latter body consists of the Directors of Agriculture of Kenya, Nigeria, Nyasaland, the Sudan, Tanganyika and Uganda, together with the Director of the East African Agriculture and Forestry Research Organisation and the Director of the Cotton Research Station.

The programme is based on the fact that cotton is a comparatively new introduction into the rain-fed tracts of Africa. The first attempt to found an extensive cotton-growing industry in Uganda, for example, occurred during the period 1903 to 1910, when a number of varieties and types of cotton were introduced, mainly from the United States cotton belt, by Government and private individuals. Since then a continuous process of adjustment of the crop to the new environment has gone on, controlled partly by trial and error in the field, but in large measure by investigations at experiment stations and in field trials by the Department of Agriculture and by the Corporation. In consequence, cotton is now firmly established as a major cash crop over wide areas.

The more immediate problems of the establishment of the crop have thus, in many parts of Africa, gone a considerable way towards being solved, and it is evident that further progress will be increasingly dependent on planned experimentation and on longer range research problems. Planned experimentation will be carried out on stations in all territories, but the longer range research problems will, in the main, be the function of the Cotton Research Station, and work on these problems will be largely designed to benefit all cotton-growing territories in Africa.

Details of the proposed programmes for the four main sections of the Station are given below.

Crop husbandry

The total area of the Station amounts to 2,240 acres, and it is hoped in time to get

The Parnell Laboratories at Namulonge, named after the first Director of the Cotton Research Station, Mr. F. R. Parnell

some 1,200-1,500 acres under cultivation, the remainder being permanent pasture, housing sites, swamp and other areas unsuitable for tillage.

Namulonge is situated in rolling country and the farming system to be adopted initially will be one of ley farming with three years' cropping followed by three years' rest under grass. Short grasses will be used for the resting leys, as elephant grass, the natural cover, is difficult to handle and to eradicate. *Chloris gayana* and *Panicum maximum* will be used in the first place, and a herd of N'ganda cattle, which has already been started, will gradually be built up to make use of the leys. Trials will be carried out to discover the most suitable size and shape for areas to be laid down to grass, in order to economise in the provision of fencing and water.

In order to guard against soil erosion and to conserve moisture in the soil the fields will be long and narrow, separated by grass roads running approximately on the contour, and tie ridging will be used over most of the farm.

The crop husbandry research programme will include rotation problems, the establishment and utilisation of leys, the place of livestock in the farming system, and the utilisation of mechanisation. Although complicated long-term experiments will undoubtedly be required eventually to solve many of these problems, in the early stages a number of small trials and observation plots will be laid down in order to obtain information as quickly as possible on such points as the general suitability of crops and farming operations which may be used in the future.

Comprehensive meteorological data will be collected in order that the crop environment can be studied more closely and estimates of "effective rainfall" worked out. Soil samples have been collected from the main cropping areas for future comparative examination and a continuous cultivation experiment has been laid out with both cotton and bananas to compare tie-ridging and flat cultivation on slopes varying from 3% to nearly 9%.

Lint investigations

A lint physiologist, who is at present being trained at Manchester University and the Shirley Institute, will be appointed to the staff next year, when detailed studies of lint development, and of factors affecting the quality of the lint, will be undertaken in close co-operation with the British Cotton Industry Research Association.

Plant development and crop production experiments have already been started, and the correlation of these with entomological and pathological studies will be used to assess the importance of pests, diseases and climate in determining plant development in the Uganda crop.

Plant breeding and genetics

The climate of Uganda is moist and relatively cool, which means that the vegetative growth of the cotton plant is normally vigorous and the growing season long. For these reasons, and because of attacks of bacterial blight and *Lygus*, a type of cotton has been developed in which capacity to put on a heavy crop quickly has been sacrificed in favour of ability to produce a fair crop, even under very adverse circumstances.

The long-term breeding objective is to obtain a heavy crop of good quality, and for such a type to be generally useful in East Africa it must be resistant to bacterial blight, *Lygus* and jassid, and must also be sufficiently variable to respond readily to selection for local conditions.

Some resistance to bacterial blight is already present in Uganda material, and work in the Sudan has shown that Upland cottons virtually immune to the disease can be produced. In the same way work at Barberton has shown that full jassid resistance can be obtained if the leaves of the plant are sufficiently hairy.

High resistance to *Lygus* is at present unknown, but a measure of resistance has been reported on several occasions in widely differing breeding stocks. By the concentration of such genes, therefore, it may be possible to achieve a degree of resistance of some practical value.

Once a reasonable degree of resistance to pests and diseases has been built up, the second stage will be to increase the yield by increasing the ratio of seed cotton to vegetative material in the plant. Progress in this direction will depend on the results of studies on the fruiting habits and reaction of the plants to climatic factors. Already a few groups of superior cropping capacity have been observed under the low temperature and light intensity conditions of Buganda, and these may be useful as parent material.

A wide range of strains from other parts of Africa will be grown at the Station, and in addition, based on the modern theory of population genetics, a mixture of strains of widely different origin, containing all the more important characters which it is desired to combine, will be bred under conditions of random intercrossing (panmixis).

This is long-range work from which practical results cannot be expected for many years, and in the meantime work on the improvement of the present commercial Uganda stocks will continue.

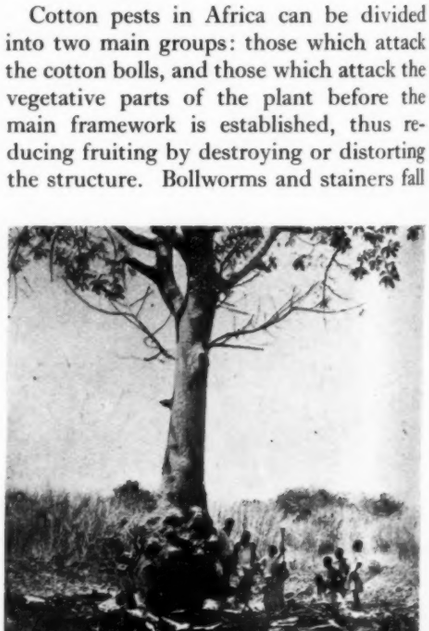
By arrangement with the Uganda Department of Agriculture the Corporation have already taken over the breeding work on BP.52, and the S.47 stocks, which are grown in the areas east and north of the Nile, will be taken over later. The division of Namulonge into three comparatively isolated blocks will make it possible to conduct a breeding programme of both varieties without risk of intercrossing.

The detailed genetics work will be carried out at Shambat in the Sudan, under the guidance of Corporation officers working in the Cotton Breeding Section. The hot dry climate and comparatively light incidence of pests and diseases (except leafcurl) make the Northern Sudan more suitable than Uganda for the maintenance and study of the type collection which now contains some 1,300 accessions. In addition it is possible to grow two crops in a season, which greatly reduces the time taken to build up new varieties by crossing.

The main genetic programme will be a continuation of the extensive work already carried out at Shambat on the genetics of bacterial blight resistance, and this will be of the greatest value to Namulonge and other African stations.

Entomology

Cotton pests in Africa can be divided into two main groups: those which attack the cotton bolls, and those which attack the vegetative parts of the plant before the main framework is established, thus reducing fruiting by destroying or distorting the structure. Bollworms and stainers fall



Land clearing at Namulonge. It is hoped to have 1,200-1,500 acres under cultivation

Much of this tall elephant grass has to be cleared; the work is done with the help of a tractor and front-mounted bulldozer

into the first group, and jassids, *Lygus* and *Helopeltis* into the second.

Bollworms, stainers and jassid are of most importance in the savannah regions of Africa which have a single rainy season. *Lygus* and *Helopeltis* are pre-eminently pests of cotton in moist equatorial zones such as Uganda.

Lygus, bacterial blight and the Uganda climate all tend to modify the structure of the cotton plant in the same way, and one of the first problems will be to disentangle the effects of each. Detailed studies of *Lygus* and of its role in determining crop behaviour will provide data on which an estimate of its present importance as a pest can be assessed, together with its probable future behaviour under changing agricultural conditions, and the prospects of its control, either directly or by the development of resistant varieties.

Work on wider issues will include studies of widespread problems which will enable guiding principles of general application to be laid down. In this connection insecticidal work is to be undertaken in co-operation with the Uganda Department of Agriculture, the East African Agriculture and Forestry Research Organisation and the Colonial Insecticides Committee, and it is hoped that much time and trouble will be saved in other territories by the establishment of guiding principles in the use of insecticides on rain-fed peasant crops of tropical Africa.

Basic entomological work will also be developed as staff and facilities permit; it should be emphasised that, while the results of the Namulonge programme will have their applications in all African cotton-growing territories, the work will not be complete in itself, but will be complemented by entomological investigations carried out by other members of the Corporation's staff in Nigeria, Nyasaland and Tanganyika.

Plant pathology

By far the most important disease of cotton in Africa is bacterial blight (*Xanthomonas malvacearum*), which may attack the leaves (Angular Leaf Spot), the stem (Blackarm) or the bolls (Bacterial Boll Disease). The greater part of the plant pathology programme to start with will be concerned with this disease.

Work in the Sudan, carried out initially on resistant varieties obtained from Uganda, has shown that bacterial blight can be controlled by the breeding of resistant varieties. The impact of the disease in Uganda is, however, different from that in the Sudan, and the relative values of particular genes may well differ also in the two countries. The situation in Uganda is further complicated, as has been mentioned before, by the interaction of *Lygus*, bacterial blight and climate in modifying plant habit and cropping behaviour.

Among the points to be studied will be the methods of infection of leaves, stem and bolls; factors influencing infection and the rate of tissue-invasion; the means of spread; the extent of carryover between seasons; the possibility of control by seed disinfection; and the physiology of parasitism, and the nature of resistance.

Wilts (*Fusarium vasinfectum* and *Verticillium dahliae*) and virus diseases are also of importance, though virus diseases are only serious in *barbadense* cottons which are only grown on a large scale in the Sudan.

Fusarium occurs in parts of the Congo, but in Commonwealth territories *Verticillium* is the common cause of wilt. This disease has caused damage in parts of Uganda, and considerable differences between varieties in wilt resistance have been demonstrated by the staff of the Uganda Department of Agriculture, from the work of their pathologists it is clear that there is a balance between soil conditions and the intensity of the attack.

It has been observed that the disease is worst in the most fertile fields, and this gives real grounds for the fear that steps towards increased production of cotton by improved cultural practices may be counterbalanced by increased severity of the disease, unless methods of checking the spread of the disease are put in hand.

Three main lines of work will be used —studies on the influence of soil factors on the activity and carryover of the disease, the influence of the physiology of the plant on its susceptibility and breeding for resistance.

The production of cotton in Colonial and Dominion territories and the Anglo-Egyptian Sudan has increased from 166,154 bales of 400 lb. in 1921, the year in which the Corporation was established, to 863,077 bales in 1948-49, the last year for which records are available. The need for sterling cotton in this country is as great as, if not greater than, it has ever been before, and the President of the Board of Trade, in a message to the annual meeting of the Corporation in June this year, said that an increase in production of cotton in the Colonies and Dependent Territories was still, and was likely to remain, of paramount importance. It is hoped, therefore, that the new Cotton Research Station, situated in the heart of the main commercial cotton-growing area of the Colonies, will play a valuable part.

Higher yielding strains bred by plant breeders and geneticists; improved methods of cultivation worked out in the crop husbandry department; adequate control measures against pests and diseases as recommended by the entomologists and plant pathologists, together with ample demonstration plots and the help and co-operation of the District Agricultural Officers, should lead eventually to a very considerable rise in the yield per acre and an increase in the amount of cotton available for Lancashire.

(Photos: Empire Cotton Growing Association.)

Treatment of 'Whiptail'

A trace element which has come into prominence of late is molybdenum. It has been found to play an important part in the nitrogen cycle by influencing the assimilation of nitrates by plants and in Australia its absence has been shown to be responsible for lack of fertility in many areas. Research investigations into a condition observed in young plants of the family *Cruciferea*, known as 'whiptail,' have shown it to be caused through molybdenum deficiency or undue acidity in the soil: the latter causing soil molybdenum to be unassimilable by crops. Experiments at Hawkesbury (New South Wales) Agricultural College showed that field applications of molybdate at the rate of ½ to 1 lb. per acre resulted in either a recovery of affected plants or a decrease in the severity of symptoms.

Cauliflowers are most commonly affected by this deficiency, but symptoms have been observed in other crucifers.

Good News for S. Rhodesia

British tobacco manufacturers have undertaken to buy 485,000,000 lb. of flue-cured leaf from Southern Rhodesia in the next six years. In the past six years their purchases from the Colony have totalled approximately 258,000,000 lb. Terms of the agreement reached by the delegation which recently went to London have been announced in a statement issued by the Southern Rhodesia Tobacco Marketing Board. The Board welcomes the innovation of substituting specific quantities for a percentage of the crop. A guarantee to purchase a percentage of the crop has been the main feature of past agreements. The new arrangement, the Board says, is more realistic. It enables the industry to estimate more precisely the quantity available for other markets.

The statement reproduces a letter received from Sir Alexander Maxwell, chairman of the Tobacco Manufacturers' Advisory Committee to the Board of Trade: 'The Marketing Board's representatives' assessment of demands in respect of the 1951 crop is at this date 122,500,000 lb. green weight. If the first estimate of the 1951 crop exceeds that figure the Tobacco Advisory Committee would not consider it a breach of this agreement if for that year export control were lifted. If the Marketing Board see reason to vary in any way the above estimate of 122,500,000 lb. for demands in respect of the 1951 crop they will consult the T.A.C. in advance of any decision to lift export control.'

Provided that there is not a further appreciable fall in total United Kingdom usings of flue-cured tobacco, and tobacco of suitable quality is available at reasonable prices, the T.A.C. undertakes that British manufacturers will be prepared to buy 75,000,000 lb. green weight in 1951; 80,000,000 lb. in 1952; 85,000,000 in 1953 and 1954; and 80,000,000 lb. in 1955—or two-thirds of the crop year by year, whichever may be the less. While the T.A.C. does not think it possible to look further ahead than five years, it undertakes also that the United Kingdom will purchase 80,000,000 lb. in 1956. Even if there is an appreciable fall in total usings, the United Kingdom will be prepared to buy 85% of the figures quoted. This represents no change in the agreement already made. The previous undertaking was to buy not less than 57% of the crop, which corresponds to 85% of the specific quantities now stated.

New U.S. Menthol Source — 100 lb./acre

The *American Bee Journal* reports that investigations into the possibilities of a hitherto untapped source of menthol have been carried out at Atlantic, Iowa, and on the basis of laboratory yields a final return of 100 lb. menthol or more per acre is envisaged from mountain mint (*Pycnanthemum pilosum*).

In its wild state the plant is found from Pennsylvania to Kansas and Arkansas growing on soils of low fertility on exposed hillsides. If it does come to have a recognised commercial value, it should be well suited to cultivation on marginal land where the conventional farm crops are unprofitable. The oil comes from glands in the hairs on leaves and stems and to obtain a maximum yield the plant should go to the still as soon as possible after cutting. The correct stage for distillation is reached in the summer of the second year and the heaviest yield of oil is obtained by harvesting at the height of bloom, which was found to be about the first week in August at the test garden in Atlantic. Analysis of the oil carried out at the University of Nebraska, showed the following results:

Pulegone 80%.
Menthone 10%.
Limonene 3 to 5%.
Menthol 2%.

Pulegone and menthone can be converted to menthol and from 100 c.c. of the oil 57 c.c. of a mixture of the menthols was produced.

In the United States 60 different industries are said to depend upon imported essential oils as part of the raw material entering into their products. At present the essential oil producing industry in America is small and the two plants most commonly used are peppermint and spearmint. Nevertheless, with the accumulating surplus of staple crops there is greater inducement to produce in the States materials that are at present secured from distant countries.

DDT Still Best for Codling Moth Control

At a recent members' day held at East Malling Research Centre, Kent, an account of the work carried out on the subject of the codling moth was given.

Dr. A. M. Massee pointed out that nowadays most pests of fruit are controllable, with the exception of a few, the most important of which are the tortricids, especially the codling moth.

Miss Joan Groves, who is the only entomologist in the U.K. working full time on codling, described the life cycle of the moth. The caterpillar, when fully fed, comes out of the apple and pupates in the nearest suitable place, which with late varieties may be in the orchard, but with early varieties may be in the orchard boxes, the grading machine or the packhouse itself. The adults emerge from the pupae from May until as late as August and shortly after emerging lay eggs on leaves or fruits. When the eggs hatch, any time between June and September, the larvae look for and burrow into the fruit. Control is effected by putting an insecticide, such as lead arsenate, on the fruit before the eggs hatch, so that the caterpillar has to eat its way through the insecticide to get at the fruit. Ideally this deposit of insecticide should be maintained till the middle of August, but this is impossible with lead arsenate, as it must not be applied within six weeks of picking date for fear of harmful effects on consumers.

The caterpillar eats out a little hole just under the skin and stays there for a week before tunnelling to the core. Some of the newer insecticides may be able to kill the caterpillar while it is just under the skin.

On the basis of her work, Miss Groves recommended two sprays of lead arsenate, the first at the beginning of June and the second a few weeks later, provided this left a clear six weeks before picking. She considered that corrugated paper bands applied at the end of July and removed after picking were valuable where the infestation is most severe. The packing shed and box stacks should be sprayed with DDT in oil during the latter part of May and, if possible, the packing shed should be kept closed to prevent moths getting out to the orchards.

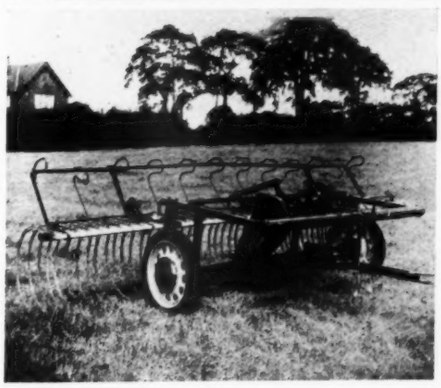
Dr. A. H. M. Kirby dealt with possible materials to replace lead arsenate, as it was open to objections on account of its poisonous nature, though very suitable from the spraying point of view. Such materials included calcium arsenate, aluminium arsenate and zinc fluoro-arsenate, but none of these had proved any less damaging to the tree or as effective as lead arsenate. So far DDT is the best of the new materials. In the U.S.A. 7,000 tests using 4,000,000 codling larvae had failed to produce anything better. An efficient acaricide must be used with the DDT, and probably it must be applied again later on. Parathion and some new chemicals are under trial for this purpose and are showing some promise. For the present lead arsenate is the best material recommended.

GREATER VARIETY AT 1950 SMITHFIELD

The main exhibition hall at Earls Court. The whole show covered more than 180,000 sq. ft.

THE second post-war Smithfield Show and Agricultural Machinery Exhibition was held at Earls Court, London, from December 4 to 8 under the patronage of H.M. the King and the presidency of the Duke of Norfolk. Many readers will have read reports of or perhaps visited last year's show which, organised on new lines to those of pre-war years, was a resounding success. The 1950 show re-established itself as one of the major events of the farming calendar, comparable with the two great European farm machinery exhibitions which take place annually in Brussels and Paris.

There were over 350 exhibitors in the machinery section, compared with 336 last year, covering an area of more than 20,000 sq. yd. and displaying between them a unique collection of machinery for nearly every conceivable job on the farm. The range of tractors extended from a 1½ h.p. horticultural machine to an 80 h.p. crawler; tillage implements, too, were of a varied nature and applicable to practically every type of farm from intensive smallholding to colonial plantation. Much attention was paid to the various sugar beet and potato harvesting machines exhibited, and their performance records in many cases showed that Britain is now ahead in the design of root harvesting machinery, although there are still improvements to be made. For instance, a really reliable potato harvester, capable of distinguishing between stones, clods and potatoes and which does not bruise the crop, has still to be designed.



(*Top*) **Ford-Ransome deep digger at work**

(*Bottom*) **Massey-Harris Dickie No. 716 tractor rake**

A feature of mechanisation which is becoming more widely recognised is the employment of mechanical handling equipment—elevators, hoist blocks, forward-mounted loaders on tractors, manure distributors, and so on. Pneumatic grain elevators are coming into prominence, largely as a result of the rapid increase in numbers of combine harvesters and the consequently greater amount of grain handling required to be carried out. Front-end loading attachments are influenced largely by American design; in that country great store is set by this type of loading mechanism, similar to that of the fork-lift truck—a loading and moving machine considered indispensable in most American factories.

The range of grass and grain driers had increased considerably since the previous year and notable were the smaller and cheaper models which must have greatly increased the numbers of potential buyers. Medium and small farms can now be equipped with suitable driers, mobile if required, and at far lower cost than, say, the driers which were exhibited on the market five years ago.

The range of mounted implements continues to expand and there were several newcomers on show which had appeared on the market since the previous year's

Smithfield. For those who were unable to witness the forage harvester trials organised by the Royal Agricultural Society, most of the machines which took part were exhibited and attracted considerable attention.

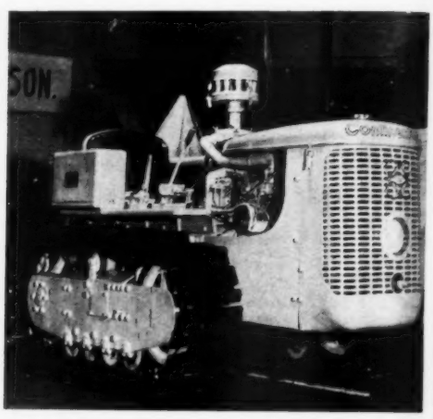
Besides implements and machinery a considerable portion of the exhibition was devoted to agricultural supplies and equipment—fertilisers, crop protection products, tyres and accessories of every description.

Great Britain now ranks second only to the U.S.A. in the manufacture of farm equipment, her home market alone now absorbing £50 million of new machinery and tractors a year. Today there are more tractors on United Kingdom farms than in the whole of Canada. Much was shown at Earls Court this year and the many overseas visitors cannot but have been impressed with the quality and ingenuity of design of the machinery that they saw.

No less with the livestock, entries of which numbered twice as many as in 1949 and only a few less than the last pre-war show of 1938. Fourteen breeds of cattle were displayed, including Devon, Hereford, Shorthorn, Aberdeen-Angus, Sussex, Red Poll, Galloway, Welsh, Highland, Lincoln Red, Dairy Shorthorn, South Devon, British Freisian and Dexter as well as cross-breeds. Formerly this exhibition was known as the Smithfield Fat Stock Show and interest was concentrated in the beasts shown. While this interest has now shifted to a great extent from live to dead stock, the quality of the cattle shown this year remained supreme.

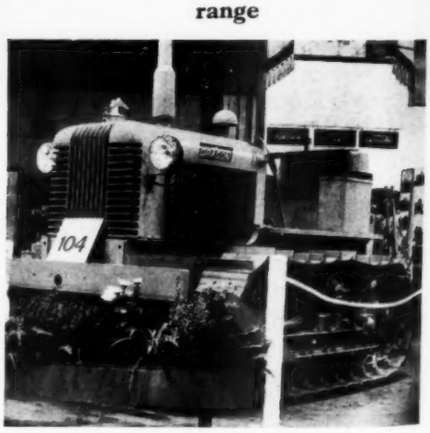
Besides cattle there were 22 breeds of sheep on show, including Leicester, Kentish or Romney Marsh, Dartmoor, Wensleydale, Mountain (other than Welsh), Welsh Mountain, Black Welsh Mountain, Southdown, Hampshire Downs, Suffolks, Shropshires, Oxford Downs, Cheviots, Exmoor Horn, Ryelands, Kerry Hill, Dorset Horn, Dorset Down, Wiltshire Horn, Clun Forest, South Devon, and

International Model 'R' green crop loader with pneumatic tyres



The new Continental CP 36, latest member of the Continental Tractor range

(*Left*) **3-year Highland steer, Radio Doctor, from Easingwold, Yorks., which received second prize.** (*Above*) **Ford-Ransome deep digger plough.** (*Right*) **Loyd 'Dragon' diesel tractor**



(*Left and centre*) **Messrs. Drake and Fletcher's Dustacub one-man powdering machine, close-up and at work.** (*Right*) **A low volume sprayer of the trailed type, manufactured by Ransomes, Sims and Jefferies Ltd., of Ipswich**

More stand pictures, taken by our photographer at the Show's pre-view. (*Top left*) **Rotary Hoes Ltd. showed their range of Rotavator attachments for tractors.** (*Top right*) **Templewood Engineering Co. Ltd. showed their provender press and cuber and Tempest and Typhoon mills, all designed for use with their grass and grain drying plants.** (*Bottom left*) **McCall and Co. Ltd. showed the 'T.L.' mobile crop drier; also the 'T.L.' grain drier, which will dry up to 60 sacks by means of hot-air pokers.** (*Bottom right*) **Mitchell, Colman and Co. Ltd. showed a range of stationary machinery, including the new spirolift auger grain conveyor, seen in the picture above; this firm's forage harvester was a prize-winner at the recent R.A.S.E. trials**

cross-breeds. Ten pig breeds shown included Middle White, Large White, Large Black, Berkshire, Gloucester Old Spots, Wessex Saddleback, Essex, Welsh, Tamworth, National Long White Lop-eared, and cross-breeds.

The total attendance at the show amounted to 49,381 — 6,758 more than in 1949. The general verdict was that the livestock exhibits were of standard and quality even better than in 1938.

Exhibitors of agricultural machinery reported that the show was an all-time record for them, both in the interest displayed and the amount of business done. The value of orders during the show is estimated to exceed £10 millions, of which over 40% is attributable to export demand.

14 ft. Tractor Rake

A new 48-tined tractor rake with a raking width of 14 ft. is announced by Massey-Harris Ltd. (see picture p. 37). The outer tines fold inwards for transport and extra speed is obtained from the rake's rubber tyres. A screw depth adjustment enables the position of the tines to be altered without undoing any nuts or bolts.

New Light Duster

A new one-man powdering machine (see accompanying photos), manufactured by Messrs. Drake and Fletcher Ltd., was on view at the Smithfield Show and attracted some attention. Powered by a 34 c.c. two-stroke petrol engine, its total weight is only 52½ lb. The powder hopper has a capacity of 25 lb. and there is a regulating valve for the feed. According to specification this new implement, known as the Dustacub, has an overall length of 50 in. (26 in. when handlebars folded for transport), height 34 in. and width (less outlets) 17 in.

14in. Deep Digger

After nearly three years of research and development the Ford Motor Co. and Messrs. Ransomes, Sims and Jefferies announce the introduction of a jointly produced single-furrow deep digger plough for attachment to the Fordson Major's three-point linkage (pictures pp. 37 and 38).

The new plough will work to a depth of 14 in. and has a variable width of cut from 16 in. to 18 in. There is a choice of

two types of Ransome bodies and a knife coulter can be fitted as optional equipment. Production of the new plough is scheduled to start in February.

French Industrial Alcohol Outlet

French petrol importers now have to incorporate alcohol in petrol before it can be sold. This has been made law by the Government in order to find an outlet for the large stocks of industrial alcohol which have been built up.

Under French law, the Government is obliged to buy all industrial alcohol, including that from beet molasses as well as wine alcohol unprotected by the laws governing French wine origins. The quantity of alcohol that importers must buy to mix with the petrol will be fixed from time to time; at present it stands at 10%.

Indian Raw Materials

The second of a series of displays organised by the High Commissioner for India with the object of presenting a picture of the economic resources of that country was opened at India House, Aldwych, W.C.2, on November 14 by the Rt. Hon. G. R. Strauss, Minister of Supply. It comprised eight sections dealing with various aspects of production, including agricultural, forestry, animal husbandry, mineral and chemical products.

The agricultural sections comprised exhibits illustrating some of the important plantation industries, including tea, coffee, sugar and rubber as well as oils and oil seeds, tobacco, shellac and spices. The important fibre industries were not, however, represented on this occasion as they formed the subject of the previous display. They included samples of the various products, photographs illustrating the conditions under which the crops are produced, and statistical information showing the magnitude and potential of actual production. The forestry section included samples of the various types of timber produced—mostly hardwoods—and a wide range of minor forest products.

Taken as a whole the exhibits provided within a relatively small compass a comprehensive conspectus of the wide range of raw materials which emanate from the Indian section of the subcontinent, while the effective manner in which they were displayed rendered easy the absorption of a large amount of information in a minimum of time.

The exhibition remained open during the months of November and December. Admission was free.

Some of the spraying machines on the Pest Control stand at the show. Machines with tank capacities of 45, 60, 100, 200 and 300 gal. were shown

Off-Flavour Orange Juice

Experiments carried out at the Florida Citrus Experiment Station have shown that benzene hexachloride should not be used on orange trees bearing fruit at the time of spraying, according to an article in *Agricultural Chemicals* (September, 1950).

It was in the autumn of 1946 that a slightly musty off-flavour was detected in the juice of oranges and similar observations were made the following year, when it was found that this off-flavour persisted in the canned product. In 1948 a series of tests was arranged to compare the effects of different insecticides and different times of application. Benzene hexachloride, high gamma content benzene hexachloride (original gamma isomer content approximately 97-98%), chlordane, toxaphene and parathion were sprayed at different dates on three varieties of citrus throughout the season, which, when mature, were picked and sampled by taste tests for possible off-flavours in the juice. From the results it appears that when benzene hexachloride is sprayed after the setting of fruit, the juice will acquire an off-flavour. High gamma benzene hexachloride was much more apt to impart off-flavours when used with oil than when used as a wettable material. Chlordane, toxaphene and parathion did not impart any off-flavours to the varieties upon which they were used in spite of the fact that the dosages of these materials were higher than would ordinarily be used on citrus trees.

'Good Husbandry'

This journal, the first number of which has recently appeared, is published in Salisbury, Southern Rhodesia. It is directed primarily to planters and farmers in the Intensive Conservation Areas in that territory, and although it is produced by private enterprise, it is the official organ of these areas. In these circumstances its first concern is with Soil Conservation but its scope also includes other aspects of farming; this is as it should be, for conservation is not merely a specialised subject but affects all matters relating to good farming. The first number, in addition to having several articles on soil conservation, also contains interesting articles on the pruning of fruit trees, the control of eelworms, composting and the outlook for coffee cultivation in Rhodesia. The publication is attractively presented and well illustrated, and it is published at the low price, today, of 1s. per issue. Our best wishes go to it for a successful career.

'Colonial Plant and Animal Products'

We have received a copy of the first number of the new quarterly journal under the above title, produced by the Colonial Products Advisory Bureau (Plant and Animal). Its appearance is a consequence of the taking over by the Colonial Office of the functions of the Imperial Institute relating to advisory work on plant and animal products, and the journal is the replacement and extension of the Bulletin of the Imperial Institute, which formerly dealt with these matters.

It will, no doubt, be welcomed in many quarters and especially in the Colonial Dependencies, since it provides a medium for publicising investigations and reports on Colonial products.

The first issue is prefaced by a message from Mr. A. Creech Jones, formerly Secretary of State for the Colonies.

The journal is edited by Mr. G. F. Bray. We wish it every success.

WORLD CROP REPORTS

O.F.C.'s increased sorghum area

The area sown with sorghum by the Overseas Food Corporation in Queensland, Australia, in 1949-50 was increased to 66,432 acres from 29,286 acres in the previous year. Final figures for the yield of this crop show a total yield of 1,240,000 bushels, or approximately 28,000 tons; the average yield per acre was 940 lb.

In the 1948-49 season the total yield was 7,050 tons which gave an average yield per acre of only 538 lb. (approx.). The low yield that year was mainly due to heavy lodging of the crop which, although lost to the harvester, proved very useful for cattle grazing.

Colonial sugar production

Figures of production and exports of sugar, relating to the principal producing British Colonies, are given below, reproduced from the *Commonwealth Survey*.

COLONIAL PRODUCTION AND EXPORTS

('000 *tons, raw values*)

Colony	*Production* 1938-39	*Production* 1948-49	*Exports* 1938	*Exports* 1948
Barbados	89	153	101	69
British Guiana ..	191	185	183	137
Jamaica	118	238	105	160
Leeward Islands	—	—	46	40
Windward Islands	68	67	8	6
Trinidad	129	159	120	80
Mauritius	316	385	288	360
Fiji	132	133	134	149
Kenya and Uganda	58	86	20	32

These Colonies together accounted for 6.7% of world sugar production in 1938 and 7.7.% in 1948, and for approximately 9% of world exports in both years.

Record Mexican rice and corn

The official preliminary estimate of Mexico's 1950 rough rice crop is 500 million lb., which is 23% more than the record harvest of 1949. Also, the corn (maize) harvest is forecast at a record 122 million bushels, compared with the 1949 crop of 90.5 million bushels and the 1935-39 average of 67.5 million.

Queensland tea trials

Tea grown experimentally in Queensland has proved to be equal to some of the best imported leaf, according to recent reports from experts of two leading Australian tea firms, reports our Australian correspondent. The tea was grown by the tropical section of the Department of Agriculture at South Johnstone, near Innisfail.

Western Australia's heavy flax crop

Flax crops in the Boyup Brook area of Western Australia are doing particularly well and a yield of about 2,500 tons of straw is expected from the 2,200 acres under cultivation. All the flax fibre on hand at the local mill has been sold, the price being some £61,000 for 220 tons.

1950 U.S. cotton crop lower

The U.S. cotton crop for 1950 is now estimated at 9,945,000 bales, according to a semi-final report of the U.S. Department of Agriculture. This estimate is more than 6,000,000 bales below the actual 1949 cotton production.

The Department said it increased the crop forecast in November because of favourable October weather and ' improved production prospects in most States west of the Mississippi.' These conditions have offset decreases in eastern States and resulted in a nearly 1% gain over the October estimate, the Department added.

The November estimate compares with 16,128,000 bales produced in 1949.

Because of this short crop the United States has set an export quota of 2,146,000 bales for the eight-month period ending on March 31, 1951.

Outbreak of 'Yellows' in U.K.

It is estimated that the U.K. lost some 25,000 tons of sugar mainly as the result of a serious outbreak of this disease in the sugar beet crop now being harvested. This will mean not only a smaller weight of roots to the acre, but a lower sucrose content in them as well. Two lines of attack were being tried: the first was that all clamps of mangold, and any roots remaining of sugar beet, should be cleared by the end of April; the second was to raise the greatest possible proportion of sugar beet and mangold stecklings in the northern counties (Lancashire, Northumberland, and parts of Scotland), where at present comparatively little of the commercial crop is grown.
(From the *International Sugar Journal*.)

Italian grain estimates

The Italian Central Statistics Institute estimates Italy's spring maize crop at 1,760,000 metric tons. The 1950 season crop is put at 130,000 metric tons, representing an increase of 4.5% on 1949; the barley crop at 291,000 metric tons—a 28.5% increase; and oats at 553,400 metric tons—a 33.4% increase.

Argentinan linseed expansion

Argentina's 1950-51 linseed acreage is estimated at about 3.7 million acres, compared with 2.7 million last season, according to the United States Embassy, Buenos Aires. Assuming normal yields and average abandonments, the coming harvest should approximate 35.5 million bushels.

Shipment of linseed was renewed this year with liftings for the first six months totalling 960,000 bushels. The United Kingdom took an advance of 803,000 bushels, against the Argentine commitment to sell linseed beginning July 1, 1950. France took 157,000 bushels.

January-June shipments of linseed oil reach 88,180 short tons, against 4,050 in the same months of 1949. Principal destinations were the United Kingdom 70% and France 12%.

Sweden's 1950 crops

Preliminary reports regarding the 1950 harvest indicate that the yield of bread grains will amount to just under 900,000 tons, which is 75,000 tons less than the previous year. The hay harvest is expected to be about 5% less. The potato yield is estimated at 1.8 million tons, which is an increase of some 80,000 tons, while the sugar-beet crop is expected to amount to 1.9 million tons, or about 170,000 tons higher than 1949. It is hoped that the increased sugar yield will enable imports of inferior sugar from Denmark, Poland, Czechoslovakia and Russia to be dispensed with.

Canadian grain estimate up

The Dominion Bureau of Statistics have issued the third and final estimate of the principal grain crops in Canada for 1950. They are listed below with comparable figures for the previous two years:

	Thousands of Bushels 1950 *Sept.*	1949 *Final*	1948 *Final*
Wheat	490,300	367,400*	393,345
Oats	414,600	316,558	358,807
Barley	179,000	120,383	155,018
Rye	14,600	10,011	25,340
Linseed ..	4,900	2,262	17,683

* Revised

Shea nut markets sought

French West Africa is seeking markets for shea nuts (the source of karite butter) from last season's harvest of approximately 13,000 short tons, according to W. D. Moreland, American Consulate-General, Dakar. Local officials believe that Western Germany may be the best prospect because Germany was the principal importer before the war. Mills for processing shea nuts existed only in Germany and Denmark at that time.

World sugar crops

The following are the first estimates of the world's sugar crops for the season 1950-51; these and the subsequent discussion of the prospects in different sugar-producing countries are abbreviated from Messrs. Czarnikow's 48th *Sugar Review:*

	Thousands of tons		
	Beet	*Cane*	*Total*
1950-51 estimate ..	12,325	21,700	34,025
1949-50	10,503	20,891	31,394
1948-49	10,050	20,698	30,748
1947-48	7,947	19,955	27,902
1946-47	7,721	18,041	25,762
1939-40	11,455	18,285	29,740
1937-38	11,054	18,064	29,118

In the beet-producing countries the campaign is now well in its stride and although climatic conditions are particularly important this season in view of the heavy tonnages to be lifted, current estimates may, generally speaking, be regarded as reflecting a fairly close idea of prospects and there should be no very wide difference between these figures and final results unless disastrous weather conditions intervene.

Harvesting in many of the cane sugar-producing areas in the Eastern Hemisphere has been proceeding for some time and a large proportion of the crops has been manufactured. Most of the large producers in the Western Hemisphere, however, do not commence the campaign until the new year and climatic conditions during the last two or three months will have had an influence on the ultimate yield.

The total of 34,025,000 tons, if reached, will constitute a record, exceeding the previous season's total which was itself a record, by more than 2½ million tons. Comparing the total with the pre-war year 1937-38, an expansion of nearly 5 million tons is to be noted.

The heavy expansion in output expected in Europe accounts for about 1½ million tons of the overall increase. In the **United States** beet producers look for nearly 300,000 tons more this season, the estimate of 1,725,000 tons exceeding the record set up in 1947-48 by some 40,000 tons.

France and **Germany** both look for a very material improvement on last season's results. In the former country an additional 450,000 tons is promised, whilst in Germany the 1,600,000 tons estimated represents an increase of 440,000 tons. The western and eastern areas have made an equal contribution to this expansion, but comparing the figures with those of two years ago, it is in the western areas where the greater development has been witnessed. The total, although the largest of the post-war years, is very much below pre-war figures, mainly owing to the loss of sugar-producing territory in Poland.

Czechoslovakia figures with the substantial increase of 150,000 tons, but the extent of the probable increase in exports depends on Government policy in regard to the domestic allocation. **Poland** promises to exceed last season's crop by some 80,000 tons, whilst **Denmark** may add 40,000 tons to the very satisfactory total reached last season. Based on last season's estimated consumption and assuming the tonnages forecast are attained, these three exporting countries should contribute 900,000 tons to the world market, or an increase of 270,000 tons over last season's estimated exportable surplus.

With an estimated increase of 135,000 tons the **United Kingdom** crop would come very near to breaking the record held since 1934-35 when a total of 593,000 tons refined equivalent was reached. **Italy** also looks for 100,000 tons increase, and her crop will not only cover home consumption but should give her a useful reserve stock. **Roumania** is credited with no more than last season despite a small increase in the area sown, whilst no increase is provided in the case of **Spain.** An increase in sowings in **Jugoslavia** of 28% goes unrewarded owing to dry weather for the estimate is no more than that produced last season.

The difference in the prospects in Europe (excluding the U.S.S.R.) this year compared with 1949-50 is strikingly illustrated by the fact that last season the 12% increase in sowings produced no more than ½% additional sugar compared with 1948-49, whilst this year the increase in sowings of just over 5½% promises to add 21% to the sugar tonnage.

The present estimates are 800,000 tons short of the 'theoretical' production, but there are nevertheless a few countries which promise to harvest a crop in excess of the calculated figure. **Belgium** is one with an increase of over 90,000 tons, or 30%, whilst the United Kingdom is shown with a yield over 5% higher than the pre-war average. **France, Sweden,** and **Denmark** are slightly in excess of the average figure. **Germany** is amongst the countries showing an unfavourable comparison with the pre-war calculation. Unfavourable comparisons are also shown in the cases of **Czechoslovakia, Poland, Roumania, Spain,** and **Jugoslavia.**

Turning to the cane-producing countries, there are less important changes. In **Java** it seems that 300,000 tons is the most that can be expected this year, whilst in **Taiwan**, which promises better things in 1950-51, a 50% reduction is looked for. In the **Philippines**, however, substantial expansion is anticipated, whilst **United States** cane producers may add 10% to their previous season's output. The **Cuban** crop is placed at 5,650,000 tons, or 180,000 tons more than last season, which accords with current official ideas in the island, although there are some in the industry who consider this to be rather a full estimate.

Amongst the British Commonwealth producers further increases are provided for in the case of **Australia**, the **West Indies** and **Mauritus,** whilst a sharp recovery is anticipated in the **South African Union**. **Fiji** and **British East Africa** will produce less owing to adverse weather conditions. The total cane crops under this heading shows an increase over last season of 170,000 tons, but not all of this additional tonnage will figure as exports, for despite the increase shown in the South African production, the Union's shipments are likely to be somewhat less than those of last season.

Pakistan's 1950-51 cotton

According to *Foreign Crops and Markets* the first official report places the 1950-51 cotton acreage in Pakistan at 2,808,000 acres, including 2,453,000 acres of American and 355,000 acres of Desi or Asiatic varieties. The corresponding first estimate for 1949-50 was 2,787,000 acres, including 2,451,000 acres of American and 336,000 of Desi. The final figures for 1949-50 were 2,866,000, 2,517,000, and 349,000 acres respectively.

Late Dutch potato harvest

Rainy weather during October-November retarded the harvest of potatoes in Holland, according to our Netherlands correspondent. The November frosts fortunately did not inflict as much damage to the unharvested potatoes as was feared, although in the south-west, where soil water level was particularly high, large amounts were spoiled by rot.

Potato harvesters were unable to deal with the crop on the heavier clay soils, but it was hoped that the whole crop would be lifted by mid-November and, provided there were no bad frosts, safely stored well before Christmas.

Turkish grain: a record

The 1950 grain crop in Turkey is a record one, sharply above the small 1949 harvest, according to the latest estimate of the Ministry of Agriculture. A wheat crop of 175 million bushels was tentatively estimated, as harvesting was being completed in some important producing areas. A crop of that size would be about 80% larger than the small output last year and about 30% larger than the 1935-39 average of 135 million bushels.